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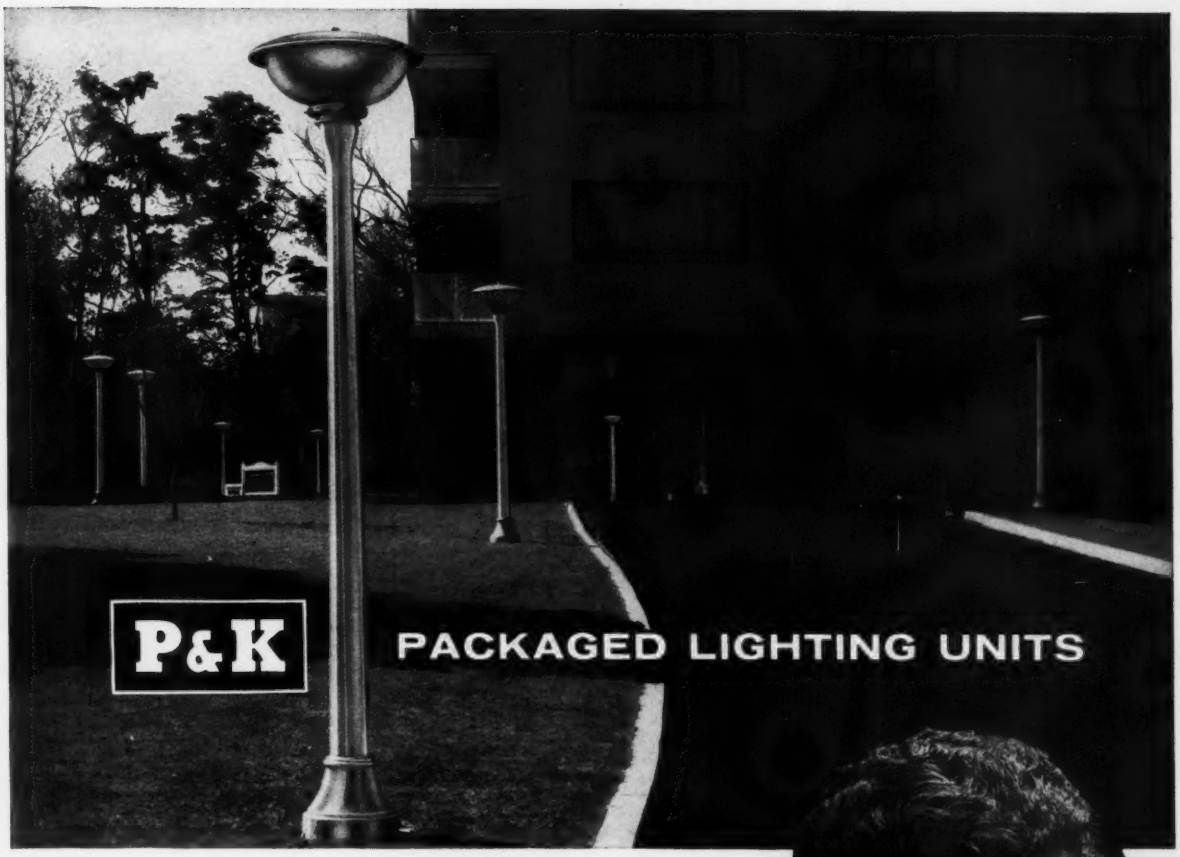

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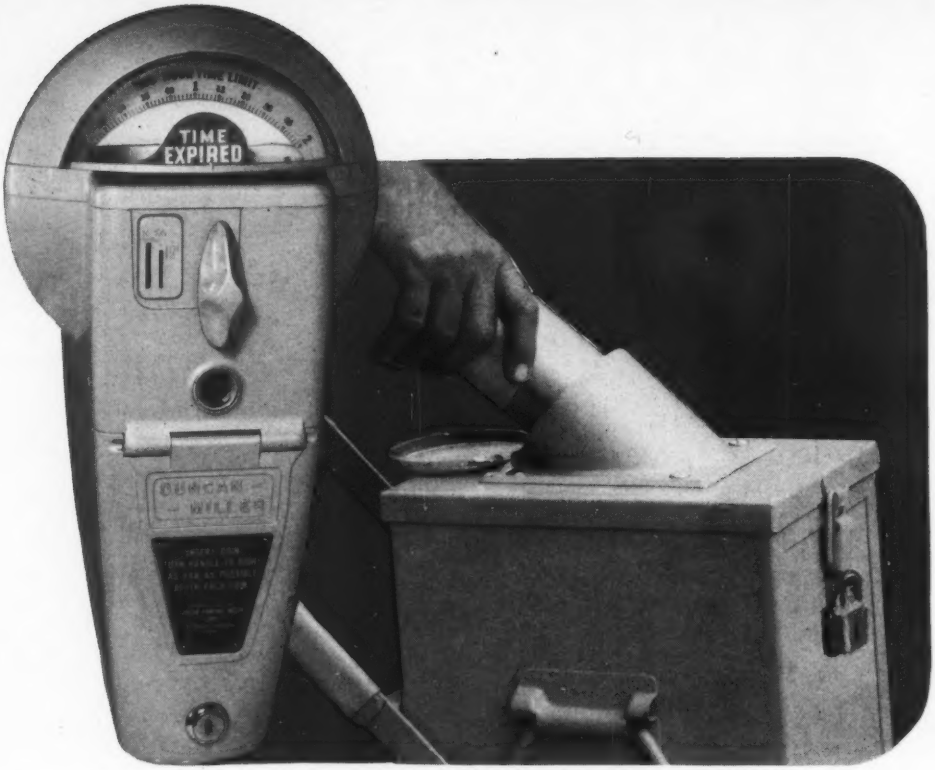

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Frankly Speaking . . .

THE ENGINEER is directly concerned with accident records, since they are his indication, along with congestion and delay, of inefficiencies in our transportation system.

Engineers use accidents as criteria for identifying problem locations, and all engineers recognize the significance of accidents in any study of design features. Location files, spot maps, strip maps, collision diagrams and other devices are used by engineers in analyzing the efficiency of operation of highway systems. Accident records thus form a base upon which the engineer measures the performance of his highway system.

In this area of accident records there is necessary a high degree of coordination between police and engineers, since police investigation reports are the best source of accident data.

The status of accident records has not materially improved in the last few years. Specifically, the present system is weak from the engineer's point of view in that it is not complete (many accidents are unreported) and that location information is often not accurate enough to pinpoint the location of rural accidents.

In addition to these problems, many of the available reports represent driver's versions of the accidents, and are therefore not good sources for the development of causal information. Too, the lumping together of investigated and uninvestigated accidents tends to distort mass statistics to a considerable extent, making them of less value to the engineer. Finally, the processing is frequently so slow that there is a substantial time lag before the engineer knows of a developing accident location.

Immediate Needs

(1) An immediate need in this field is for prompt introduction of practical and workable forms and procedures now under discussion by several national groups to develop better basic information, including separate tabulations of uninvestigated accidents, and a new classification method to identify accidents on access control facilities whether urban or rural.

(2) States need to make every effort through logs, mileposts and any other measures to aid in the identification of accident scenes on rural and access control highways.

(3) Help needs to be instituted in the form of field service to assist states and cities in the improvement of their records systems and the adoption of the new procedures referred to above.

Long Range Needs

(4) Some organization needs to take the leadership in developing and improving accident records procedures.

(5) Administrators, both state and local, need to recognize the potential value of accident records and give the necessary budgetary and other support for a sound records system.

(6) Most important of all, states and other capable agencies need to insist on getting the accident information they need, and then to program the necessary money and personnel to see that needed data for accident prevention is produced. Engineers must stop using the present inadequacy of the data as an excuse for doing little to help the situation, and they need to meet the situation head on and recognize their responsibility for conducting, sponsoring or cooperating in research on highway safety.

— Excerpted from a report submitted by the Institute of Traffic Engineers to the Public Officials Traffic Safety Conference, Washington, D.C., December 9 & 10, 1957.

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Effect of Highway Lighting On Night Capacity

By Paul C. Box
(Jun. Mem., ITE)
Street Lighting Engineer
Kansas City, Mo.

This paper was winner of an Honorable Mention in the 1957 Past President's Award competition of the Institute of Traffic Engineers. It is condensed from a thesis submitted to the Yale Bureau of Highway Traffic, 1957.

A study was made of headways and speeds on a four-lane divided highway to determine any effect roadway lighting might have on basic capacity at night. Day and night operations were compared separately at two locations. One site was unlighted, and the other was provided with fixed lighting. At the unlighted location headways below 3.75 seconds were found to increase about 6 per cent at night in the right lane, and about 4 per cent in the left lane. At the lighted location no headway loss was experienced in the right lane at night, but the left lane showed the same loss as for the unlighted site.

The speed checks at both locations were comparable by lanes, and a night reduction was found under both lighted and unlighted operation. The loss under lighting was about 2/3 the loss without lighting.

The conclusions gathered from the data studied are as follows:

1. Highway lighting apparently prevented a 5 per cent loss in night *capacity* of the right lane; such loss being experienced when the road is not lighted.

2. Highway lighting apparently had little effect on the speeds; reductions being found under both lighted and unlighted conditions.

The foregoing conclusions should not be considered necessarily representative of all divided highways. The sites studied had certain limitations which may have prevented them from being entirely "typical."

Introduction

STREET LIGHTING has generally been credited with several worth-while accomplishments in the traffic operations field. Among these are night accident reductions and improved efficiency of interchange operations.(1) The former service is of greatest need where pedestrian street crossings are involved, or where lighting not only reduces accident hazard, but increases efficiency by showing up location and direction of ramp intersections a sufficient distance ahead of the night driver for proper lane changing to take place.

In the tangent and curvature sections of the modern freeway facility, open cross section and high design type horizontal and vertical curves generally afford near-maximum utilization of vehicular headlighting equipment. Pedestrian and roadside interferences are limited, if not largely excluded, as a potential hazard. It is questionable whether lighting such sections is economically justified, in view of present-day concepts of this lighting value. Of interest, however, is the possibility that fixed lighting might have additional advantages in relation to the basic ability of a given facility to carry its traffic load during the peak night hours.

The efficiency of operation of any highway evolves around the number of vehicles per hour attempting to pass over it in comparison with the number it is designed to handle. The design volume is based on lane capacity, as affected by certain physical construction features. The basic lane capacity is a direct function of minimum vehicular headway. This headway is determined solely by the proximity of the vehicle ahead and the judgment of the rear driver. Headway has been accepted as varying with speed; ranging downward from an initial 3.1 seconds at 10 MPH to 1.7 seconds at about 38 MPH, then increasing at about 0.1 second per 10 MPH increment of higher speed. These figures are based on headway measurements made of thousands of pacing vehicles, i.e., one trailing another at approximately the same speed.(2)

Studies have shown that in the change from day to night driving conditions speeds are reduced.(3) Headway capacity measurements made on two-lane rural highways have also shown that the average driver demands greater headways at night for the same speed brackets.(4) Urban-type peak hour volumes may occur after darkness during the winter months. Speeds of less than 40 MPH can be considered typical of urban conditions. This is the range where decreased speeds result in increased headways and lowered basic capacity, according to the accepted theory as outlined above. Thus night capacity could be considered to suffer a double loss, as a product of increased headways from both lowered speeds and driver preference. Any improvement lighting might be able to make in either of these factors could, if properly evaluated, constitute an additional tool for maintaining capacity at the day or design level.

This study sought to determine (a) the night-time change in speeds and headways on an unlighted portion of a specific facility, and (b) the change on a similar section of the same facility which had been provided with fixed lighting. By comparing only the percentage change between day and night at each location, the effect of unavoidable differences in physical site

(1) *A Policy on Geometric Design of Rural Highways*, American Association of State Highway Officials, 1954, Washington, D. C. p. 184.

(2) *Highway Capacity Manual*, Bureau of Public Roads, 1950, p. 27, 28.

(3) R. C. Johnson & F. W. Hurd, *Rural Speed in Missouri*, Missouri Highway Department, Safety Bureau, Jefferson City, Missouri, 1941, p. 7; R. L. Meyer, *Hourly and Daily Variation in Vehicle Speeds on a Rural Highway*, Yale University, Bureau of Highway Traffic, New Haven, Connecticut, 1950.

(4) O. K. Normann, "Results of Highway Capacity Studies," Bureau of Public Roads, *Public Roads*, vol. 23, no. 4, June 1942, p. 58.

characteristics aside from lighting were minimized.

Collection of Data

Ideal analysis of the effect that lighting has on night capacity would require data collected from the same site before and after installation of lighting. Such a location was not available at the time of this study. A portion of Connecticut Route 15 was chosen as a compromise, since sections of similar physical characteristics were available both with and without lighting. This route, known locally as the "Berlin Turnpike," is a four-lane highway consisting of 27-foot slabs with 8-foot paved shoulders, and divided by a 21-foot medial strip. No apparent control of access has been employed, and extended sections are heavily infested with typical outlying commercial development. The route is intersected by a number of local roads and state highways spaced from one-fourth to one mile apart. Most of the intersections have been signalized, and these signals have been progressively timed for speed control of the 45 MPH posted limit.

In order for the two study sites to be reasonably comparable, the special route characteristics had to be equalized. This was attempted by selection of sites at about the same distance from signals and well removed from immediate roadside development. One additional qualification was that the lighted location must be situated so that the night drivers have had adequate experience in driving under lighted conditions. Similarly, the unlighted location must be located where night drivers have been away from the effect of lighting a sufficient time for "normal" unlighted operation to be experienced.

In accordance with those specifications, the sites shown in Figure 1 were selected. Site A is unlighted, and Site B is provided with modern highway lighting producing an average maintained pavement illumination of 0.8 horizontal footcandles.

Data collected consisted of combined speed and headway measurements made by fully automatic actuation of a graphic recorder, plus headway measurements made by manual key actuation of the recorder. The checks logged approximately 6,600 vehicles and were performed on four dates as shown in Table I.

TABLE I

TOTAL VEHICLES RECORDED

	Site A				Site B			
	Right Lane		Left Lane		Right Lane		Left Lane	
	Day	Night	Day	Night	Day	Night	Day	Night
30 Oct. 1956	—	—	—	—	165	127	147	78
13 Nov. 1956	274	318	221	237	—	—	—	—
12 Feb. 1957	—	—	—	—	347	393	308	171
17 Mar. 1957	280	515	269	571	409	636	433	666
TOTALS	554	833	490	808	921	1156	888	915

Analysis of Data

Capacity is a function of two factors, headway and speed.(1) The choice of headway distance is almost entirely at the discretion of the individual driver. The choice of speed is initially also a pure driver choice; however, it is modified by conditions partly or entirely beyond the driver's control. These modifications may be forced, as in the case of a traffic density which makes maintenance of desired speed a physical impossibility. The speed may be artificially inhibited by legal limits, roadway alinement, adverse weather, or mechanical limitations of the vehicle. Evidently a study of the nighttime effect on highway capacity, either lighted or unlighted, must compare characteristics which are purely driver choice, or which are equally inhibited under all conditions of the study. Headway measurements would thus appear to be first choice, with speeds under relatively free-flowing conditions as a secondary approach.

The highway capacity studies conducted by the Bureau of Public Roads have indicated that initial interference with "free" vehicle operation takes place when the driver reaches a point about 9 seconds behind another vehicle in the same lane.(2) At this point the driver begins to consider several alternate patterns of behavior. He may continue at his existing speed, thus closing on the lead vehicle, followed by forced speed matching or passing. Second, he may accelerate and commence passing maneuver at any point up to a few feet behind the lead vehicle. A third choice lies in matching the lead vehicle speed at some distance behind and "pacing" for an indefinite distance, despite opportunities to pass. There are thus two conditions of pacing, *forced* (while awaiting passing opportunity), and *voluntary*. As the traffic volume on a route increases it becomes progressively more difficult to sort one class of pacing from the other. At very heavy volumes, the average speed of the route will usually have dropped to such a low value that the majority of drivers approach the forced conditions. The remaining voluntary pacers will of necessity also have reduced their headways to maintain their proper place in the traffic stream, otherwise they will have the gap in front of them filled by some less cautious driver overtaking from the rear.

Headway measurements made during day and night driving conditions will often encounter different volumes. If values at one location consist mainly of "forced" type headways, and in another of mostly "voluntary" type, certain inconsistencies should be expected to appear when data are compared. While our knowledge of driver behavior is insufficient to predict the exact circumstances under which different classes of pacing characteristics would be expected, an approximation can be made. In this study, only those vehicles "bracketed" by leading *and* trailing cars were extracted for the headway analysis. For the bracketed driver, an element of pressure analogous to high volume conditions is maintained. The writer believes a first approximation of strictly forced type headways is obtained by this approach.

A second element of uncertainty in comparing headway values lies in the selection of a "cut-off" point. The use of the 9-second value of initial interference would presuppose that a majority of drivers strive to maintain this headway as a minimum. Traffic studies of vehicular volumes experienced on numerous routes across the country

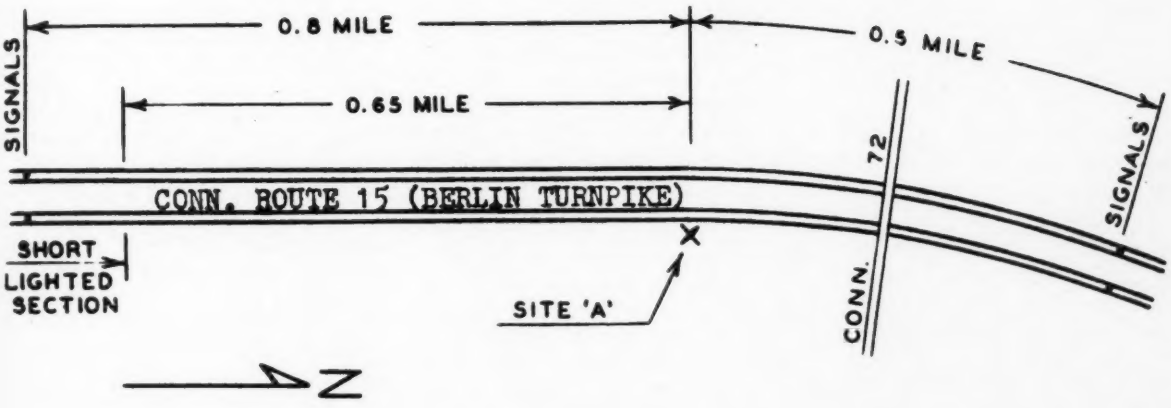
(1) Highway Capacity Manual, op. cit, p. 28.

(2) O. K. Normann, "Preliminary Results of Highway Capacity Studies," *Public Roads*, vol. 19, no. 12, Feb., 1939, p. 228.

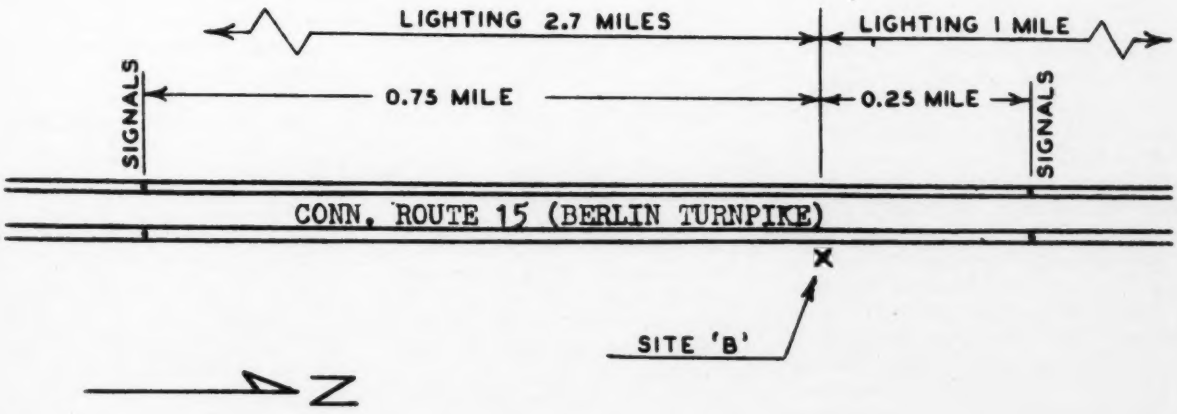
SITE "A"

SITE "B"

PHOTOS LOOKING SOUTH



LOCATION DATA, SITE "A"



LOCATION DATA, SITE "B"

Figure 1

show conclusively that less than 9 second headways are consistently utilized. The Highway Capacity Manual studies concluded that average headways of 3.6 seconds could be considered normal for uncongested lane flow of a high design type multilane facility with an operating speed of 45 to 50 MPH.[3] For speeds of 40 to 45 MPH the headway average was 2.9 seconds, and for 35 to 40 MPH the average was 2.4 seconds. Evidently, for these averages to be obtained, some vehicles would have greater values and some lesser values. Inclusion of all headways measured would then have little significance, except for providing a volume index for a particular speed range.

In the pacing headway studies by the Bureau of Public Roads, only those headways of 3.75 seconds and less were included.[4] While any number of different cutoff points could be considered, with valid arguments pro and con, the writer feels the use of this figure should at least provide measurements comparable with the exhaustive previous studies.

Headway Analysis, Site A

A total of 1050 vehicles were logged at Site A by both headway and speed. Screening of this data to include only vehicles pacing at one MPH maximum speed difference resulted in 314 useable measurements. When further classified into speed increments of five MPH, by lane, and by day or night condition, the data lacked sufficient sample size for development of definite headway trends. This was true not only for groupings within particular speed classes, but also when considering a lane by condition of day or night, and with all headways grouped. Statistical examination of the assembled data indicated sample sizes of 200 to 300 would be necessary for significant mean differences at the 0.1 second level desired.

Further analysis of the data based on consideration of bracketed type headways, instead of pacing, indicated strong trends of significance. The 3.75 seconds value of headway for both leading and trailing vehicles, i.e., 3.75 seconds for both the car being measured and the one behind, was employed. Additional measurements were made of headways to confirm the trend. These studies did not include speed measurements, since adequate data was available from the earlier work on route operating speed.

TABLE II

BRACKETED HEADWAYS AT SITE A TO 3.75 SECONDS

(Combined data from checks taken 13 Nov. & 17 Mar.)

	Right Lane		Left Lane	
	Day	Night	Day	Night
Sample Size	224	326	248	494
Average Headway (Seconds)	1.94	2.06	1.63	1.69
Night Percentage Change		+6.2%		+3.7%

Table II compares the headways found under the different conditions of day and night operation at this unlighted site.

Headway data included in this Table were scaled to the nearest 0.05 second, and were tabulated in 0.1-second class intervals. Application of a test for significance of the difference between day and night mean headways develops the probability of the differences found occurring by chance only. Applying this test to the right lane, the probability of chance occurrence is one in 50,000 times, and for the left lane it is two in 100 times. This does not prove that the differences found in this study are necessarily the actual differences, but only indicates a high probability that a reduction of some magnitude *does* take place in the headways of both lanes at night. In the absence of further data the differences found can be utilized as finite values for comparative purposes.

At lane volumes of 1500 VPH, headways of 3.75 seconds or less constitute about 80 per cent of total flow.[5] The net capacity reduction at night for this unlighted site would therefore be $.80 \times 0.062 = .05 = 5$ per cent for the right lane. The left lane is similarly reduced $.80 \times 0.037 = .03 =$ 3 per cent at night. For urban type facilities, the design capacity of 1500 VPH assumes 12-foot lanes and adequate lateral clearances. Reduction of the lane width to 11 feet reduces capacity about 3 per cent and to 10 feet about 9 per cent.[6] Under urban design hour conditions, the night capacity loss is thus approximately equivalent to the use of a 10.5-foot width for the right lane. The left lane loss is equivalent to the use of 11-foot lanes.

Increase in volume above 1500 VPH increases the percentage of vehicles with short headways. Therefore the loss of capacity increases with volume. Figure 2 relates the night effect on capacity to various lane volumes.

Headway cutoff limits of less than 3.75 seconds may be considered in assessing the night effect on capacity reduction. Since the percentage of vehicles below a stated value of headway is directly related to volume, the net capacity effect must be reanalyzed for each point chosen. Checks made at reduced headway cutoff values show reasonable consistency in the night capacity losses as developed above. For example, approximately 65 per cent of the vehicles in a lane volume of 1500 VPH are maintaining headways at or below 2.5 seconds. Analysis of the data at this point shows an increase of 9.2 per cent in right lane headways at night, and 2.7 per cent in left lane headways at night. Relating these values to the proportionate volumes, gives 6.0 per cent night capacity reduction for the right lane, and 1.8 per cent for the left lane. The effect of darkness on left lane volumes appears to decrease with the very short headways. However, the sample sizes available below 2.5 seconds are too small to be highly significant.

Headway Analysis, Site B

Screening of basic headway and speed data at the lighted location left inadequate sample sizes for "pacing" type analysis. A total of 1740 vehicles were logged, yielding only 486 measurements of pacing vehicles with one MPH maximum speed difference. Since entirely adequate samples were available for definition of speeds, additional studies were made of bracketed type headways only. Headway data combined from the several checks is indicated in Table III.

Comparison of Tables II and III indicates a net night improvement in

(3) Computed from the accepted Highway Capacity Manual volumes for the speed ranges indicated.

(4) "Results of Highway Capacity Studies," op. cit, p. 57.

(5) "Results of Highway Capacity Studies," op. cit, p. 72, Fig. 18.

(6) "Highway Capacity Manual," op. cit, p. 3.

TABLE III

BRACKETED HEADWAYS AT SITE B TO 3.75 SECONDS
(Combined data from checks taken 30 Oct., 12 Feb., & 17 Mar.)

	Right Lane		Left Lane	
	Day	Night	Day	Night
Sample Size	240	294	410	384
Average Headway (Seconds)	2.17	2.13	1.69	1.77
Night Percentage Change		−1.9%		+4.7%

the right lane headways of about 8.0 per cent, and an increased loss in the left lane of about 1.0 per cent in the lighted section of the highway. Testing for significance of the difference between day and night mean headways gives a probability of chance occurrence of 17 in 100 for the right lane data, and 1 in 10,000 for the left lane. The left lane difference is highly significant, but the right lane reduction in mean headways found is quite possibly a chance occurrence. All three checks were consistent in showing a night reduction, but this cannot be statistically verified from the data. The left lane showed a headway increase at night in two checks, and a decrease in the other. Because of small sample size for the "decrease" check, the combined data reflects the increase. With the large total sample sizes considered, the only definite conclusion which can be drawn from the data is that the left lane headways are apparently not affected by lighting. A night reduction is found for both lighted and unlighted conditions.

The headway data, as compared directly for the two sites, shows generally longer values at Site B under the control condition of daylight. Evidently the two sites are not directly comparable. If they are not comparable by day, it is possible they also may not be comparable by night in other factors than lighting. Studies of multiple sites, which was beyond the limitations of this paper, are clearly indicated. Perhaps the peculiar signal system characteristics result in a re-compacting of platoons between the two locations studied. In this event, it appears logical to expect changes to affect the night movement equally with the day. The writer feels comparison of night to day values separately by sites, as undertaken in this work, offers the best solution to inequality of driving factors.

The data shown in Tables II and III consist of average headway values of vehicles traveling at different speeds. These speed ranges were very narrow, as will subsequently be brought out. The 10 MPH pace includes ⅔ to ¾ of the vehicles in all the studies. Because of this close speed grouping, only slight error should have been introduced by averaging headways for all speeds within a particular lane. It is really questionable, considering typical driver inattention to speed, coupled with average speedometer error, whether any consistent headway value measured for a particular speed is so sensitive as to not be equally applicable to a close range of adjacent speeds. The driver establishes his minimum headway in feet (or more properly his space gap between the front of his vehicle and the rear of the lead vehicle), by his own depth perception. This distance is modified by his past driving experience, and momentarily affected by psychological pressures, such as recent annoyances and immediate traffic conditions. His space gap is not a reasoned or computed product of his true speed versus his gap in feet, seconds, or reaction time distance. It is a sensed distance value, and because of inherent sensory limitations, it must be a random value within certain ranges. These ranges have yet to be accurately defined.

If this postulate of near-equivalence between speed and headway is accepted, the day to night comparisons made in the Tables are meaningful, and the data should be basic, at least to the route studied.

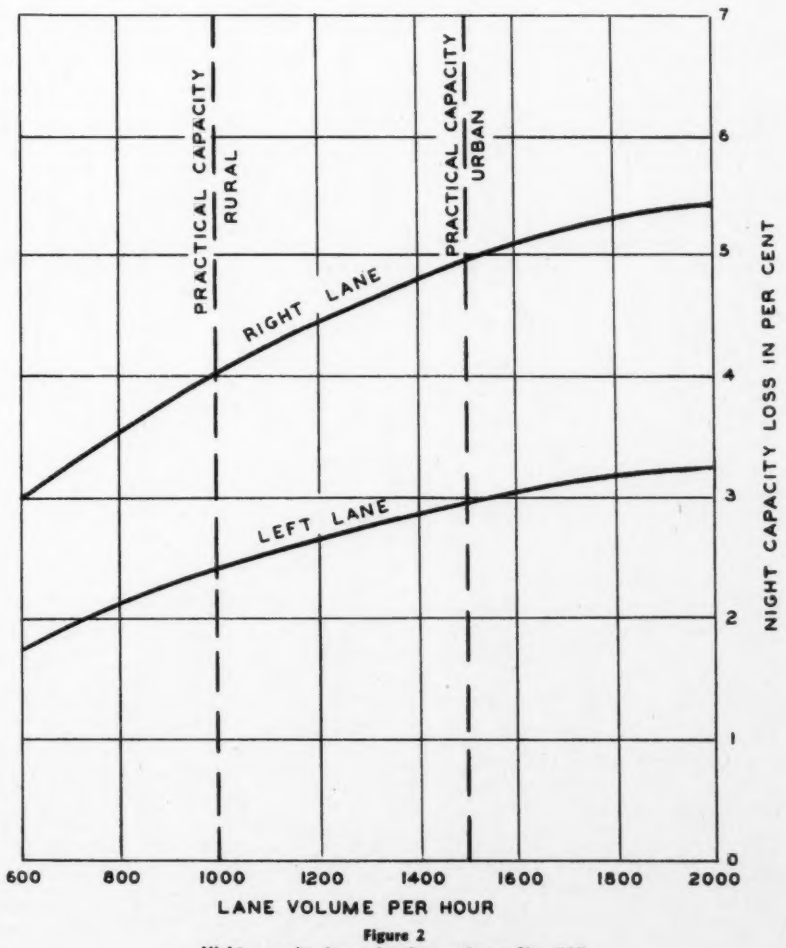


Figure 2
Night capacity loss related to volume. Site "A"

Speed Analysis

The range of average speeds found is largely between 45 and 55 MPH. These are desirable values for a free-flowing facility, and will accommodate nearly 85 per cent of the measured driver desires as determined from studies of free-moving spot speeds.[7]

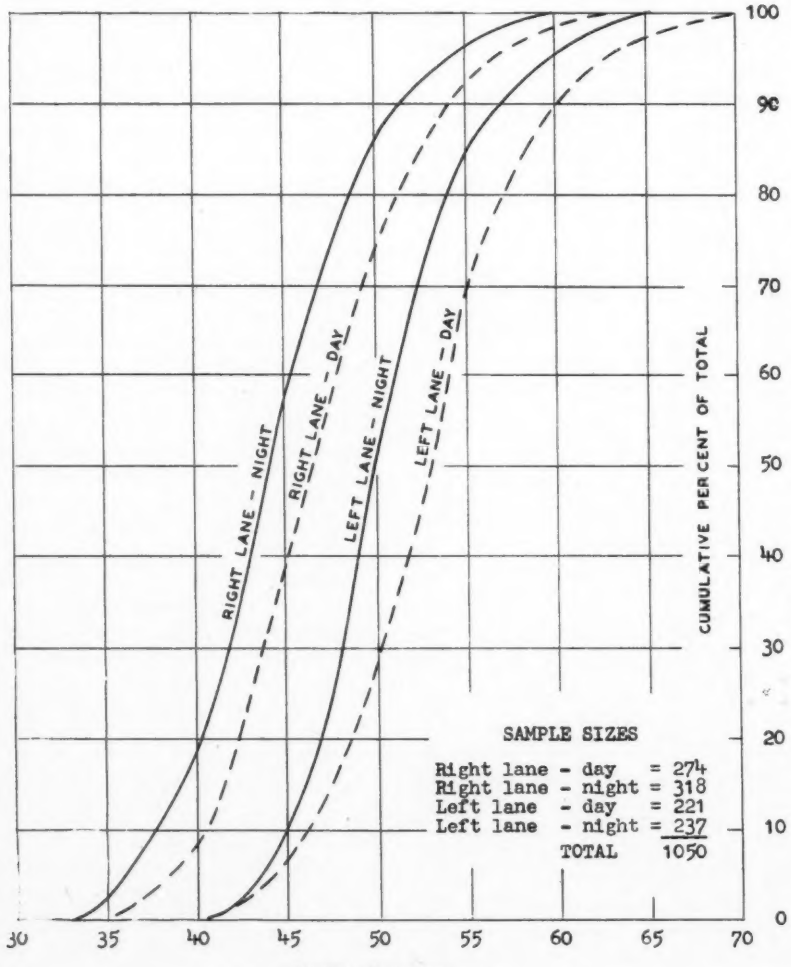
(7) "Influences of Alinement on Operating Characteristics," Proceedings Highway Research Board, 1943 vol. 23, p. 331.

In the headway analysis, unavoidable differences in site characteristics precluded direct comparison between the two locations. The speeds are, however, quite similar by lanes. Both sites show a reduction at night, with the lighted section losing slightly less speed than the unlighted location. Table IV below, compares sites by lanes, day and night, and relates the losses found.

TABLE IV

AVERAGE DAY AND NIGHT SPEEDS, BOTH SITES

	Site A (Unlighted)	Site B (Lighted)
Right Lane		
Day	48.0 MPH	48.6 MPH
Night	45.7 MPH	46.8 MPH
Night Loss	2.3 MPH	1.8 MPH
Left Lane		
Day	54.5 MPH	54.1 MPH
Night	51.8 MPH	52.2 MPH
Night Loss	2.7 MPH	1.9 MPH



CUMULATIVE SPEED CURVE

SITE A (UNLIGHTED)

Figure 3

The loss under lighted conditions as shown in Table IV is about three-fourths the loss under unlighted conditions. Cumulative frequency curves for both sites illustrate this graphically in Figures 3 and 4.

It will be observed that the average speeds were in all cases in excess of the posted 45 MPH limit, on which the progressive signal timing is ostensibly based. In one case at Site A, 93 per cent of the drivers were exceeding the speed limit. This is graphic evidence of the lax enforcement of speed laws on this route. This is also evidence of driver resistance to observing a speed limit which would work to his advantage, delay-wise, i.e.; allow his continuous, progressive movement at a reasonable speed. From the standpoint of this study, however, the observed lack of restraint makes for a more typical picture of traffic movement than would otherwise be the case.

The data for Site B was taken on different dates, as previously indicated, and has been combined for use in Table IV and Figures 3 and 4. This was done because minimum desired sample sizes of 200 vehicles per lane per condition (day and night) were not uniformly available in the data collected. The first check at Site B did not show any appreciable night loss in speed. The second check at this site found strong night losses, but volumes were lower. According to established doctrine, a reduction in volume should result in greater speeds.[8] Perhaps the singular type of signalized speed control produces an anomaly in this case. It may be more pertinent to recognize the limited sample sizes included in the first check. Table V summarizes the data collected, and relates individual checks to both lanes and total directional volume.

Examination of this Table discloses that, when volumes between Sites A and B are reasonably comparable at night (as in the Site B, 1st check), the speed reduction in the lighted section is insignificant. This evidently cannot be stated as a blanket conclusion for two reasons. First is the limited sample size, and second is the unknown effect of platooning. Certainly volume per hour under phased and compact groups is not directly equivalent to the relatively random longitudinal distribution of an equal number of "free-moving"

(8) "Results of Highway Capacity Studies," op. cit, p. 61, 63.

vehicles for the same period. The volume is, however, related to the platoon size or density. Thus, the combination of data for widely varying rates of flow per hour does not result necessarily in aberrant results where platoons are involved. In essence, the platooning produces many of the qualities found in relatively high rates of traffic which are desirable to this study, but due to the platoon gaps, driver attitudes, and the lax enforcement, the speeds are not too artificially inhibited for "free" type measurements to be made.

Conclusions

The headway loss found in the right lane for unlighted night operations appears to be the most significant result of this study. Prevention of this loss by fixed lighting has been demonstrated for at least the route under consideration. If studies of other facilities bear out this finding, perhaps contribution of construction capital for the purpose of lighting would be warranted to a certain degree.

The night capacity loss avoided by lighting is equal to 5 per cent at an urban design hour volume of 1500 VPH. This has been shown to be equivalent to the loss which would accompany construction of a 10.5-foot instead of a 12-foot wide right lane. If the conservative figure of $6.00 a square yard is assumed for pavement cost, the wider lane costs about $1.00 a lineal foot more, or slightly over $5,000 a mile. Considering both directions of travel, a contribution of $10,000 a mile toward lighting might be similarly justified where the maintenance of maximum night capacity is desirable.

The value of lighting with respect to speed is debatable. The Highway Capacity Manual has shown that a straight line relation usually exists between speed and volume.(9) This applies specifically to facilities where drivers are not influenced by a speed limit. (From the average speeds observed on the Berlin Turnpike, this route would appear to fall in to "uninhibited" category). An increase of 120 VPH per lane is taken as grounds in the Manual for assuming a one MPH decrease in average speed. If the converse were assumed to hold true, then the small *difference* in speeds lost between the lighted and unlighted section of the route under study would

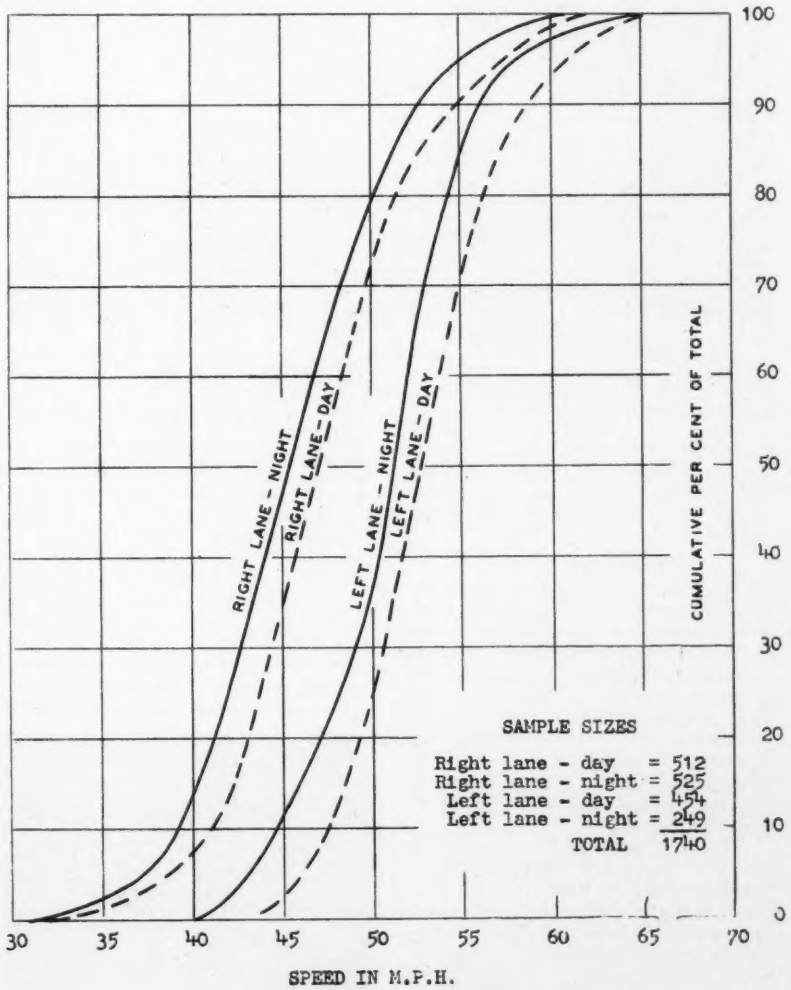
(Continued on page 23)

(9) "Highway Capacity Manual," op. cit, Fig. 7.

TABLE V

AVERAGE DAY AND NIGHT SPEEDS RELATED TO VOLUME

	Average Speed	Lane Volume	Total Volume	Sample Size
		Right Lane — Day		
Site A	48.0 MPH	530	960	274
Site B, 1st ck.	51.0 MPH	690	1280	165
Site B, 2nd ck.	47.5 MPH	550	1020	347
		Right Lane — Night		
Site A	45.7 MPH	450	790	318
Site B, 1st ck.	51.3 MPH	510	820	127
Site B, 2nd ck.	45.5 MPH	270	380	398
		Left Lane — Day		
Site A	54.5 MPH	430	960	221
Site B, 1st ck.	53.4 MPH	590	1280	146
Site B, 2nd ck.	54.4 MPH	470	1020	308
		Left Lane — Night		
Site A	51.8 MPH	340	790	237
Site B, 1st ck.	53.2 MPH	310	820	78
Site B, 2nd ck.	51.7 MPH	110	380	171



CUMULATIVE SPEED CURVE

SITE B (LIGHTED)

Figure 4

Reflective Pavement Marking . . . what to look for when you buy it

As an engineer, you quite naturally want quality of performance in the pavement marking material you lay down. Yet performance alone cannot be the sole yardstick in evaluating quality because of the cost factor involved. The final selection or recommendation you make, then, actually becomes the result of evaluating all facets of performance in the light of dollar value received.

To help you in this important evaluation, here are a few facts about reflective pavement markings in general, and one product in particular, premixed, "Centerlite" Reflective Compound.

Modern striping unit in Milwaukee, Wisconsin, shows quick, easy one-step application of "Centerlite" Reflective Compound. Reflective beads are pre-mixed in striping compound. Rugged film holds beads in tight grip. Beads give a hard, long-wearing surface to resist traffic wear. You get durability in both reflectivity and in the stripe. You get what you want—performance and economy.

Pre-Mix Durability

Of the two basic types of reflective marking materials, the pre-mix type (where reflective elements are mixed in the compound by the manufacturer) gives you a primary advantage of greater durability. In fact, "Centerlite" Reflective Compound has repeatedly demonstrated its superiority in this department by lasting up to three times longer in actual on-the-pavement tests than other types of reflective markings.

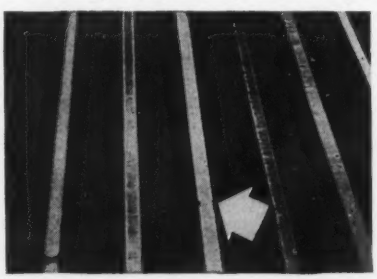
Why the longer life? Because the reflective beads are distributed uniformly throughout the stripe and held in the grip of a rugged film. The characteristics of this film are such that the tightly gripped beads don't flick out easily. Traffic wear is minimized because the film guards and holds the beads in place, and the beads, in turn, provide you with a hard, long-wearing surface.

This durable double-action is an exclusive of pre-mixed striping. Any other reflective stripe type soon loses surface beads to traffic wear, lessening resistance to abrasion and also diminishing its reflective quality as time and traffic pass. The point of durability is a primary advantage of the pre-mix material because it helps give you a *lower* cost per foot per day of useful life. It is certainly one of the things to look for when you buy.

One-step Application Ease

Another significant advantage of pre-mix striping is in application. With "Centerlite" Compound, you have only one item to order, to store, to handle. And because the beads are already in the mixture, you apply the stripe in one fast pass. Humid or windy days pose no problems. The stripe dries quickly . . . and you have reflectivity over every inch of marking, whether on flat or super-elevated planes.

This application ease, too, contributes to lower cost per foot per day of useful life. "Centerlite" Compound can also be easily applied by almost every striper. No settling in the tank, no extra gun wear, no gun clogging.



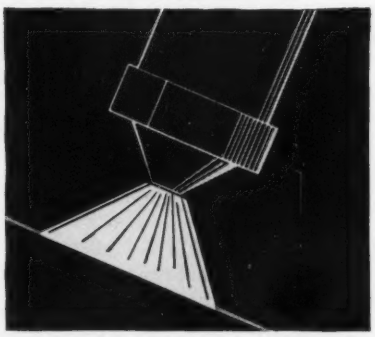
All lines applied on same day. Photo taken after 8-month test proves performance of "Centerlite" Reflective Compound (arrow).

Lifetime Reflectivity

From the safety standpoint, pre-mixed "Centerlite" Compound gives you advantages in lasting brightness that other types of reflective markings can't match.

The reason for this, again, is the fact that the reflective beads are all through the striping compound. So, when your line is laid down, wherever there is paint, there is reflectivity. No chance for spotty, unreflective areas.

As the stripe wears, and they all do, new beads in pre-mixed "Centerlite" Compound are constantly exposed. Reflectivity *lasts the full life of the stripe.* You get, combined with the *lower* cost per foot per day of useful life, the *highest* performance factor. And this is the combination that means you get the performance you look for and the economy you demand.



New "Centerlite" Compound gives you easy, one-step application. Pre-mixed reflectivity stays uniform even on superelevated sections.

Your 3M Distributor or Representative will be happy to supply you with more facts as well as with "Centerlite" Compound itself. Or write to the 3M Company, Dept. GS-18, St. Paul 6, Minnesota.

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Inform the Driver

(An Approach to Positive Speed Signing)

By W. H. Carsten
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Director, Department of Traffic Control
Dallas, Texas

MR. AVERAGE DRIVER is not a voluntary law breaker, nor will he exceed reasonable limits if he has knowledge of what they are. But, compliance with regulations can hardly be expected if the limits are not within reason or if the driver is not informed. Common among complaints of drivers hailed into court for speed violations are:

"I didn't realize I was in a speed zone"; "The speed limit is too low"; or, "I didn't see any signs."

In competition with strategically located advertising signs, oversized billboards, flashing beacons and the like, the inconspicuous speed sign has a difficult job of getting its important message across.

In the matter of reasonable speeds it has been pretty well established that only about 15 per cent of the drivers are "nuts" of one kind or another and that 85 per cent will normally drive at or below a reasonable rate of speed. Speed zones in Dallas have been established (using radar speed meters) on the basis of this concept and in general are believed to be equitable.

Perhaps Mr. Average Driver would not agree to the equitableness or reasonableness of the established limits at certain locations, but factors other than the roadway section itself must enter into the picture and into the decision as to what the speed limit should be. Uncontrolled access, heavily built-up residential or business areas, traffic volume density, accident frequency, pedestrian exposure, etc. all must be given consideration in arriving at a proper speed limit. Uniformity of speed zoning or maintaining the same speed over extended sections of the same road, likewise must be weighed carefully so that the driver can spend most of his time watching the road rather than looking for speed change signs.

Figure 1
". . . lower or higher speed limit."

"But, Officer, I thought this was a 45-mile per hour zone." This, or similar explanations, must be given hundreds of times a day throughout the country, and in the majority of instances the driver is sincere. In those cases somebody "goofed"—the driver, who intentionally didn't see the posted limits; or the engineer, who may have given too little thought to the erection of signs. If we are to expect observance of speed regulations, they must be properly posted — the driver must be informed when speed changes occur. This should be done by positive signing and the messages should be located so they are easily and quickly read.

The Texas State Legislature has set the speed limit within corporate limits at 30 miles per hour on residential and business streets but has given the governing bodies of the cities (based on engineering surveys) authority to zone speeds either up or down. In Dallas, with its 250 square miles of area and its 2200 miles of state highways, farm-

Figure 2
". . . larger or oversized speed limit signs."

Figure 3
". . . a double-barrelled message."

Figure 4
Three-dimensional pavement marking.

to-market roads and city streets — many that traverse areas that are rural in character — speed zoning has been employed extensively. As a matter of policy, those zones posted at 30 miles per hour (the blanket legal limit) or less, are posted with the conventional black-on-white reflectorized sign. Permissible speeds in excess of 30 miles per hour are signed with reverse screening, that is, white on black. This is designed to enable the driver at a glance to recognize a lower or higher speed limit. The format of the sign itself is such as to aid in readily identifying the posted limit, and emphasis is placed on the size of the numerals, which, of course, is the important part of the sign. Standards for speed signs are 12-inch numerals, visible and readable at a distance of 600 feet, according to the rule-of-thumb that "each inch of numeral height is equivalent to fifty feet of perception distance." In concentrated urban areas it is believed that this size speed numeral is a desirable standard but on those roads characterized by rural conditions and higher speeds, even bolder messages are necessary. On rural approaches to congested urban areas, and particularly on state highways, where traffic has been authorized speeds of up to 60 miles per hour, larger or oversized speed limit signs are installed.

The attention of the driver is called to a speed zone change by two methods; first, the mounting of a supplementary sign over the speed sign, bearing the legend, "Begin"; this gives the sign a distinctive shape and permits quick recognition by the driver; secondly, at every location where a speed change occurs, 10-foot high reflectorized numerals are placed on the pavement adjacent to the speed change sign. This is kind of a double-barrelled message to the driver—if he misses seeing the sign, he has the painted numeral to remind him, visible at either day or night.

To confirm the fact that the driver is within a new or different speed zone, a second speed limit sign is erected from 200 to 300 yards beyond the initial sign or beyond the point of speed change. To keep drivers constantly informed and to eliminate uncertainty regarding legal limits, requires the posting of signs at relatively short intervals, particularly on those roads where frequent speed changes occur. One-half mile intervals are considered a maximum for erecting speed limit

signs and in short zones the intervals are considerably less.

Through capital improvement programs Dallas has been able to construct many miles of 6-lane, divided roadways, which because of their design, permit higher safe speeds. Limits on these roadway sections are posted from 35 miles per hour in concentrated residential or business areas to 50 miles per hour where the area traversed is not too heavily built up.

On the majority of business and residential streets the speed limit is 30 miles per hour, unless otherwise posted. It is not necessary, incidentally, to post the 30 miles per hour limits, for this is a blanket speed set by the State, and in absence of any speed signs, the driver knows automatically the permissible speed. On expressways the policty of setting minimum, as well as maximum speeds, has been adopted. Recognizing that speed differential of vehicles is the cause of many of the highway accidents, and that drivers of slow-moving vehicles often are indirectly responsible for accidents (that they themselves might never figure in) a speed range is posted showing minimum and maximum allowable speeds. This posted range, which permits a 10-miles-per-hour speed variation, is designed to eliminate the extremes, that is, to slow down the speeder and speed up the slow ones. It is just as much a violation to travel under the minimum posted speed as it is to travel in excess of the maximum—and probably, safetywise, a whole lot more hazardous for the other fellow.

Control of vehicle speeds at "school zones" or at those locations where elementary school children are required to cross thoroughfares, adjacent to schools, is accomplished by portable speed zone signs. These signs, which inform the driver his speed must be reduced to 20 miles per hour, are placed on either side of marked crosswalks by school patrolmen, who supervise crossings at school start and dismissal. The first sign, stationed in advance of the crosswalk, tells the driver he is in a school zone and to reduce his speed, while the second one, beyond the crosswalk, advises him to resume his normal speed. The signs are in place and the restriction in effect for only a short period of time in the morning and again in the afternoon, while during the remainder of the day the regular posted limits are in effect.

(Continued on page 37)

Figure 5
"35 mph on major thoroughfares."

Figure 6
". . . minimum and maximum speeds."

Figure 7
". . . reasonable restriction for a short period of time."

Basic Theory of Electronic Computers

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Edwards and Kelcey
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Introduction

THIS PAPER IS CONCERNED with an explanation of the basic theory underlying the operation and use of electronic computers. It does not undertake to describe any of the applications made by our office and others to such problems as traffic assignment, origin-destination analysis, etc. It is hoped that a broader understanding of just what a computer is and how it works will aid others in adapting this new tool to the problems of traffic engineering.

General

An electronic computer is essentially a simple desk calculator with two important differences. It can add, subtract, multiply and divide at a very high speed and perform long series of operations automatically.

Computers fall into two main categories known as analogue and digital machines. In an analogue machine, numbers are represented by the measurement of physical quantities such as the rotation of a wheel or distance along a scale. Examples of analogue machines are the planimeter and slide rule. Digital machines, examples of which are the desk calculator and standard punch card machines, work directly with numbers in digital form. This paper is limited to a discussion of digital computers, which are used almost exclusively for highway and traffic engineering work.

There are five components of any digital computer that enable it to solve a problem. These five components are called:

1. Input Unit
2. Memory Unit
3. Arithmetic Unit
4. Control Unit
5. Output Unit

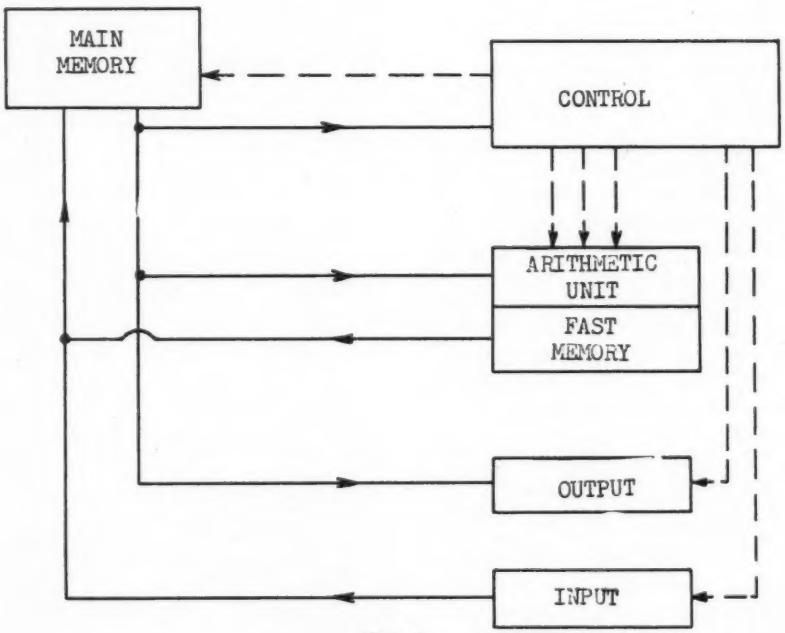


Figure 1
Block Diagram of a Computer.

1. Input Unit

The computers must be given data to operate on and also instructions on what operations to perform. This is accomplished through the use of punched cards or punched tape. The machine "reads" the tape or card by means of either a series of brushes or a photo-electric cell. Whenever a hole appears in a card a circuit is closed and a pulse of current is sent into the machine.

2. Memory Unit

The pulse of current that has been caused to flow by the hole in the tape or card now goes to an electromagnet which puts a magnetic spot on the surface of a rotating drum. Each number we send into the machine can be identified by a recognizable pattern of these magnetic spots on the drum. These spots will stay on the drum until we deliberately remove them and so the computer can be said to have "memorized" the number we gave it.

While the putting of spots on the drum takes but a split second, even more speed is needed at certain times for efficient operation. This is done by having a smaller secondary memory which may be based on condensor storage. Numbers can be sent into, or called out of, this secondary memory at a much faster rate than from the main memory and this is very important in achieving high speed arithmetical operations.

3. Arithmetic Unit

Just as the human computer has a desk calculator, the electronic computer has its "black box" of electronic circuitry which can add, subtract, multiply or divide the numbers supplied to it.

4. Control Unit

The instructions which we supplied to the machine must operate in the cor-

NOTE: This paper has been adapted from a thesis written by the author as a student at the Yale University Bureau of Highway Traffic.

rect order and actuate the proper circuits to carry out the desired operations. The portion of the machine that does this is known as the control unit.

5. Output Unit

Once the machine has obtained the final answer or any in-between result that we may wish to keep, some means must be provided for getting this information out of the machine. This can be done by reversing the input process and having the machine punch the results in a tape or card. Commonly, however, the computer is connected directly to an electric typewriter which will print out the results in the form of letters and numbers.

The flow of data in the computer is illustrated in Figure 1. The dotted lines represent the guidance of each unit by the control while the solid lines represent the actual transfer of information.

Machine Language

The language that the machine understands is a simple one, usually based on some form of the binary system; that is, a "yes-no" system of communication. A relay is either opened or closed, there is or is not a magnetic spot on the drum, there is or is not a hole punched in the card.

The code of a typical machine makes use of seven possible units of information to represent a number. Two of these units are called the binary portion of the code and have been assigned the values of 0 and 5. The remaining five units are known as the quinary portion of the code and have been assigned the values, 0, 1, 2, 3, and 4. When this code is used, all digits 0-9 are represented by the combination of one binary and one quinary unit of information. This is illustrated below where:

x represents the presence of an electrical charge.

o represents the absence of an electrical charge.

Digit	*Binary Units*		*Quinary Units*				
0	x	o	x	o	o	o	o
1	x	o	o	x	o	o	o
2	x	o	o	o	x	o	o
3	x	o	o	o	o	x	o
4	x	o	o	o	o	o	x
5	o	x	x	o	o	o	o
6	o	x	o	x	o	o	o
7	o	x	o	o	x	o	o
8	o	x	o	o	o	x	o
9	o	x	o	o	o	o	x

The translating of the decimal-digit representation of the input data into the bi-quinary representation required for internal transmission and use is done automatically by the machine. The user needs to think and work only with the normal digits and decimals he is accustomed to using.

Programming

There are several important characteristics of electronic computers that govern the way they are used and the form of the problems that are submitted to them. The most important characteristic is that the circuits of the machine are built to perform only certain basic operations, one at a time. This means that every problem solved on the machine must first be broken down into a set of step-by-step operations, each of which corresponds to a machine instruction. The process of breaking down a problem and coding the steps in terms of machine instructions is known as programming.

Programming would be a prohibitive task were it not for the fact that the machine can modify basic instructions by itself in the course of a computation and thus to some extent, supply its own instructions. Also, the machines can perform certain functions such as computing the sine of an angle, logarithm of a number, square root, etc., automatically through the use of subroutines already programmed by the manufacturer.

Programs are troublesome and time consuming to devise; this restricts the use of computers to problems which occur over and over again or which would require an excessive amount of time for manual computation. Once a program has been written and checked, it can be used for the same type of problem by changing the input data to correspond to the new problem. Mr. H. A. Radzikowski, of the U.S. Bureau of Public Roads, is currently compiling a library of programs written for the highway and traffic field which will be available to those desiring to use them.

Other Machine Characteristics

Electronic computers can make logical decisions regarding alternate computing routines by comparing two numbers. Thus, we can end a series of successive approximations when the difference becomes negligible or use one diversion curve for trips under a specified length and another curve for trips over the specified length.

The machines can look up tables and select the correct value for any combination of horizontal and vertical components we supply it. Diversion curve data, for example, can be sent into a machine and it will select the percentage of diverted traffic for any two ratios of time and distance.

No machine built yet can exercise the slightest degree of common sense. They will operate on any number, regardless of how illogical or obviously in error it appears, in just the same fashion as if the number were valid. If for some reason the value of the percentage of diverted traffic obtained from a diversion curve was 9000 per cent instead of 90 per cent, the machine would assign an impossible number of trips to the proposed expressway.

High manufacturing and maintenance standards, along with built-in checking devices, restrict the major source of error in an electronic computer to the human beings who use it. The program being used to solve a problem should have a number of checks incorporated in it. We have all used checks on our hand calculations such as adding numbers in a table vertically and horizontally and comparing the two totals, using two methods to get the same answer, etc. Similar checks should be put into the program wherever warranted.

One of the major advantages of computers is that they don't get tired but continue to grind out correct answers to a dull problem for hour after hour without losing efficiency. After the initial task of writing and checking out the program is completed, computers can furnish answers that are more accurate, cost less, and take only a fraction of the time required for manual solution.

Flow of Numbers Inside Computer

As was stated earlier in the paper, a hole in a punch card can close a circuit which will cause a pulse of current to be sent to an electromagnet; thus placing a magnetic spot on a rotating drum. The surface of the magnetic drum is divided into many divisions each of which can hold one number and is called a *register*. Each register in a typical machine has room for ten digits and an algebraic sign. The contents of the register is called a *word*. Also, each register is numbered serially to provide a means of identification and this serial number is called its *address*.

Let us consider a typical operation that a machine does. It might be described as "take the number in register A, add it to the number in register B and put the result in register C." We could represent this symbolically by:
A + B to C and we also could have
A − B to C
A × B to C
A ÷ B to C

We could streamline this by dropping the word "to" and assigning numbers to each of the arithmetic operations, such as 0 for addition, 1 for subtraction, 2 for multiplication and 3 for division. We have already assigned a serial number to each register and so now it is possible to write this instruction using numbers only. For example, 125, 2, 136, 257 could specify "take the number in register 125, multiply it by the number in register 136, and store the result in register 257." Now the computer has such electronic circuits in its control unit that every time it receives a series of pulses of current corresponding to the numbers 125, 2, 136, 257 it does take the number in register 125, multiplies it by the number in register 126, and stores the result in register 257. These pulses of current that actuate the circuit could be sent into the machine from holes in a punched card or could be caused to flow by the pattern of magnetic spots that had previously been placed in the memory unit.

The code described above is known as a "three address code" because the three addresses of the registers used were given in one word. Other codes, such as the modified single address and double address, where the word in the instruction register contains only one or two addresses, are also in common usage.

It should be pointed out that once the instructions have been put into the form of numbers, they can be stored in the memory or operated upon in the arithmetic unit just as if they were only numbers. The ability to store instructions internally, and execute and modify them internally, is the primary difference between an electronic computer and other forms of punched card equipment. The ability to operate upon instructions is very important in programming, as will be shown later in this paper.

Example of Computer Operation

For every different model of computer there is a list of instructions that the computer is capable of executing. The ability of the computer to perform these operations is determined by the circuits built into the computer. Although the instruction lists of most computers contain certain basic instructions, such as add, subtract, shift, and others, the details in the steps taken to execute the instructions can vary considerably from one machine to the next. However, the same principles of programming can be applied to practically all computers. These principles will be explained through the use of a "specimen" machine. Although the list of instructions that the "specimen" machine can perform is much shorter than those found in actual practice, they are never-the-less realistic.

Instruction List for the "Specimen" Machine

The "specimen" machine has a 1000 word memory, uses a single address

Instruction	*Code*	*Description*
STOP	00	The computer stops regardless of the digits in the address part of the instruction.
RESET AND ADD	01	The accumulator is reset to zero, and the number at the indicated address is then placed in the accumulator.
ADD	02	The number at the indicated address is added to the number in the accumulator and the sum is left in the accumulator.
SUBTRACT	03	The number at the indicated address is subtracted from the number in the accumulator and the difference is left in the accumulator.
MULTIPLY	04	The number at the indicated address is multiplied by the number in the accumulator and the product is left in the accumulator.
DIVIDE	05	The number in the accumulator is divided by the number at the indicated address. The quotient is left in the accumulator and the remainder is lost.
SHIFT RIGHT	06	The number in the accumulator is shifted to the right a number of places indicated by the number in the address part of the instruction. Digits shifted to the right from the units position are lost.
SHIFT LEFT	07	The number in the accumulator is shifted to the left a number of places indicated by the number in the address part of the instruction. Digits shifted to the left of the ten thousands position are lost.
STORE	08	The number in the accumulator is placed in the storage location indicated by the address part of the instruction. The previous contents of this storage location are lost; the number in the accumulator is unchanged.
STORE ADDRESS	09	Same as STORE except that the number in the accumulator is assumed to be an instruction and only the three digits corresponding to the address part of the word are sent to storage. The digits corresponding to the code in both the accumulator and the address location are unaffected.
JUMP	10	The next instruction is taken from the address indicated by the address part of this instruction instead of the next sequentially numbered address position.
JUMP IF MINUS	11	Same as JUMP if the number in the accumulator is negative (zero is assumed to be positive); otherwise the next instruction is taken from the next sequentially numbered address position.
READ	12	One word from the input mechanism is placed in storage at the indicated address. The previous number at this address is lost.
PRINT	13	The word at the storage location indicated by the address is recorded by the output mechanism. The number in storage remains unchanged.

code, and each register can hold one word of five decimal digits with sign; any word can represent either an item of data or an instruction. When a word is used as an instruction, the first two digits will serve as a code to indicate the operation to be performed, and the last three digits will represent the address; the sign will not be used in the case of instructions. Normally the computer will start by executing the instruction found at address 000 and will continue by executing instructions found at sequentially numbered addresses except when a jump type of instruction is encountered. Beside the one thousand storage locations (designated by addresses 000 through 999) in the main memory, there will be one other storage unit, called the accumulator, which will act as the arithmetic unit of the computer.

Basic Programming Techniques

To illustrate the basic procedure which is used to cause the computer to proceed through a sequence of operations, the instructions required for the "specimen" computer to compute $XY+Z^2$ and print the result will be shown. Assume that means have been provided for placing the program and the data in the main storage unit of the computer. The first instruction will appear at the storage location designated by successively higher numbered addresses. The data, X, Y, and Z, may be stored at any convenient addresses not needed for instructions; in this example, locations 009, 010, and 011 will be used.

Address	*Contents of Address*	*Description of Operation*	*Remarks*
000	01009	RESET AND ADD	Places X in the accumulator.
001	04010	MULTIPLY	Forms XY in the accumulator.
002	08012	STORE	Places XY at address 012 for temporary storage.
003	01011	RESET AND ADD	Places Z in the accumulator.
004	04011	MULTIPLY	Forms Z^2 in the accumulator.
005	02012	ADD	Forms $XY + Z^2$ in the accumulator.
006	08012	STORE	Places $XY + Z^2$ at address 012 for temporary storage. (The previous contents of 012 are lost).
007	13012	PRINT	The number representing $XY + Z^2$ is printed.
008	00——	STOP	The computer stops. The address part of this instruction is of no consequence.
009	X(5 digits)	—	Given data
010	Y(5 digits)	—	Given data
011	Z(5 digits)	—	Given data
012	( )	—	Reserved for temporary storage.

Recall that when a storage location is used for storing an instruction, the sign is not used, the first two digits represent the operation in coded form, and the last three digits indicate the address part of the instruction. All five digits with the sign are used as one number when storing an item of data.

In the above program the purpose and function of each instruction is explained through the comments in the "remarks" column. Note the desirability of stopping the computer on step 008. If the computer is not stopped, it will automatically proceed to interpret the items of data as instructions. Since the digits of X, Y, and Z could represent any of the instructions, all manner of unpredictable and unwanted operations might result.

Modification of Instructions

As has been mentioned previously, one of the outstanding features of most stored program computers is their ability to modify an instruction (particularly the address part of an instruction) by means of the same arithmetic circuits that are used for performing computations on data. As an example, assume that it is desired to

(Continued on page 50)

HIGHWAY LIGHTING

(Continued from page 15)

constitute a capacity factor, favoring the lighted section to the following degree:

> Right lane, difference of loss between lighted and unlighted =0.5 MPH = 60 VPH equivalent volume. Left lane, difference = 0.8 MPH = 100 VPH equivalent volume.

Equating these volume differences to the design capacity of 1500 VPH for the urban-type facility, indicates a 4 per cent improvement in the right lane, and a 6 per cent gain in the left lane.

These speed improvement factors related to capacity form a nebulous platform, and their value is questionable from several standpoints. Most important is the fact that the data from which the speed differences were derived were taken from volumes which varied considerably. Secondly, it was shown in Table V that the speed pattern on the Berlin Turnpike did not show a consistent response to the different volumes. For these reasons, the conclusion must be stated that capacity improvements as effected by speed are not clearly defined in the data gathered, and a positive contribution of lighting to speeds cannot be assigned in this study.

The relation of night to day operation of our highways cannot be fully evaluated without extensive studies. The effect of highway lighting should be explored in more detail, so that the advantages in maintenance of design level capacities at night may be better spelled out. Studies are especially needed under conditions of high illumination levels (1.0 to 2.0 footcandles), and very high densities of traffic operation. When the space gap between vehicles approaches the minimum, lighting effects can no longer be entirely evaluated in terms of pavement brightness in horizontal footcandles. At very close spacings, the driver can hardly see the pavement, consequently lighting for seeing by silhouette discernment is no longer adequate. Direct obstacle illumination provides for seeing by recognition of surface detail. This class of high intensity lighting should therefore dominate design for heavy vehicular operations.

The type of study undertaken in this report evolves primarily around driver characteristics at relatively close spacings, but the lighting available on the Berlin Turnpike is insufficient for general surface detail recognition. The results of a duplicate study under high-intensity lighting might show a considerably greater significance.

Traffic News

Public Officials Meet at Call of President's Committee for Traffic Safety

Public officials from all over the country met in Washington December 9 and 10 to agree on a program to present to four planned regional public support conferences this spring.

Engineering was discussed by a workshop led by C. R. McMillan, President of AASHO and South Carolina Highway Commissioner and George W. Howie, ITE Director and Cincinnati Director of Utilities and Traffic. ITE Executive Dave Baldwin served as secretary.

The Engineering report adopted by the Workshop and the Conference follows:

REPORT ON ENGINEERING

Appraisal of Status

Engineering plays a leading role in the field of traffic accident prevention. With the advent of the construction program envisioned by the Federal-Aid Highway Act of 1956, engineering has assumed an even greater importance than it held in previous years. Engineering is charged with the responsibility for the successful completion of this vast enterprise, and must at the same time meet the challenge of modernizing the functionally obsolete facilities which must continue to serve the increasing needs of traffic.

Engineering serves traffic safety in at least two distinct although closely related areas. The first of these is on the planning and design phase, and the second is in the maintenance and operation of the highway after it is built. Our present highway system has rapidly become obsolete in the face of increased traffic volumes and speeds. The situation is complicated in cities by an even older street system in many cases, and by poor administrative authority and procedures. The operation of a transportation system in a city or a metropolitan region is a major undertaking and one which is made unwieldy and inefficient by overlapping jurisdictions, by absences of an adequate and competent staff, and by lack of good administrative practices.

Appraisal of the 12 recommendations made for engineering in the Action Program indicates many substantial achievements in the engineering field. A step by step examination of the recommendations indicates the following developments:

1. The 1956 Federal - Aid Highway Act, providing for the development of the Interstate System and for increased aid for other highways, is perhaps the most outstanding accomplishment in the highway field in the history of the nation. Design standards and policies for the Interstate System will provide the safest road design yet envisioned by the engineers. While a number of problems exist in carrying the road program to a successful conclusion, in general this recommendation of the Action Program has been well met at the national level. The need remains for State and local governments to assume their proportionate share of the problem of needed streets and highways.

2. Although no completely adequate method of determining priority for the treatment of grade crossings has been developed, there has been progress in the elimination of crossings and in providing protection at existing crossings. It is important to note that no railroad grade crossings will be permitted on through roadways of the Interstate System.

3. State highway departments are increasingly providing sidewalks and other pedestrian - protection facilities where needs are indicated. Sidewalks are not uniformly provided in suburban areas and new subdivisions, however, and there has as yet been no major agreement on standards for school crossing protection.

4. Maintenance of roadways is at a reasonably high level. An increasing number of engineering agencies are making periodic checks of the skid resistance of roadway surfaces subject to heavy flow and are taking remedial action where need is shown. New roads are generally being provided with adequate shoulders, but improvements are needed in the case of older roads which do not meet present-day standards for pavement width or shoulder width.

5. Substantial improvements have been made in lighting in many cities, but in suburban and rural areas there is much to be done. Other than lighting at interchanges on new highways, there has not been much lighting provided for rural roads.

6. The organizational status of traffic engineering and planning has improved in the past few years. In a number of cities the department has been made one of the principal departments of city government. In most States the traffic engineering function is reported as comparable in authority to other major highway department divisions. It is difficult to draw specific conclusions because the pattern of department organization varies widely from State to State and city to city.

The extent of utilization of factual data is relatively good, particularly from the standpoint of State highway department use. There is need for more such data, particularly on accidents, as emphasized in the research report.

7. Substantial agreement on vehicle sizes and weights has been reached among States, with weights and sizes frozen at least temporarily by the 1956 Act. There is pressure, however, to increase the width beyond 8 feet, thus making the modern 12-foot lane obsolete and dangerous. It is expected that the current Road Test Project of the AASHO will produce data useful in developing a new policy on sizes and weights.

8. The sign and signal systems under state control are remarkably uniform. On a local level, however, there are a number of variations which need attention and correction. The growing mileage of expressways, particularly on the Interstate System, has emphasized the need for standards especially designed for these roads and their special problems. Work is under way in this area and uniform sign standards are needed for access control highways not on the Interstate System if full uniformity is to be achieved.

9. Speed restrictions have been following a trend toward absolute limits in preference to prima facie limits. The Uniform Vehicle Code now has been modified to recommend abosolute limits. Thus, while engineers would usually prefer prima facie limits, the Code and State statutes seem to be coming closer together. There is still need for factual information on the

advantages of one type of limit over another.

Progress toward speed zoning has not been outstanding. It is believed, in fact, that a major weakness of our traffic control program today lies in the great number of unrealistic, unenforceable and unreasonable speed limits.

10. Some progress is being made today in establishing liaison between motor vehicle manufacturers and those responsible for highway design and operation. More cooperation and coordination is necessary, however.

11. Some success is being achieved in coordinating the efforts engaged in planning, housing, zoning, street and highway development and other activities related to traffic safety. It is significant that States, particularly through efforts of the highway department planning surveys, have far surpassed local agencies in this field. Work of the National Committee on Urban Transportation, however, offers hope of similar achievement in cities.

12. Engineering research into human and physical factors relating to safety and vehicle operation is progressing. As is pointed out in the research report, however, much more needs to be done.

Immediate Needs

1. Construction of the Interstate System to adequate standards in the shortest possible time without neglecting the other rural and urban road systems, particularly those which take traffic to or from the Interstate System.

2. Public understanding of the advantages and need for control of access and proper highway locations to serve the traffic safely and efficiently on both new and existing facilities.

3. The prompt re-evaluation of traffic control and operational characteristics of roads and streets affected by the construction of new facilities.

4. Comprehensive study of the operation of all existing controlled access facilities to determine if other design factors are needed to reduce accidents and operating problems.

5. Expansion of off-street parking facilities with the construction of limited access highways in urban areas.

6. Uniform road condition reporting, detour marking and proper signing for carrying traffic over roadway sections under construction, especially during the widespread construction period of the accelerated road program.

7. Inclusion in designs for limited access highways of plans for smooth integration of traffic with the local street system.

8. Public understanding and patience during the early development period of the big road program when so many persons and businesses will be inconvenienced in many ways.

9. Determination of the type of highways required for vehicles of various sizes and weights to establish optimum economic balance between road life and road use.

10. Adequate salaries and attractive employment conditions in all jurisdictions dealing with highway construction, operation and maintenance in order to acquire and retain competent engineering personnel.

11. In-service training program for technical personnel to develop maximum potential of existing manpower.

12. Adoption and use by all jurisdictions of uniform traffic controls, traffic laws, and enforcement for the various classes of facilities with an understanding that the prerogative of a local jurisdiction to regulate the traffic on its own roads should be preserved.

13. Better use of modern engineering techniques and principles by all jurisdictions in the location, design, management and maintenance of all road and street facilities.

14. A program to speed zone all highways to establish realistic, reasonable and enforceable limits which will result in renewed respect for law and for safer, smoother traffic movement.

15. Better supervision and control of street maintenance and of other public services when and where they may conflict with the safe and efficient movement of vehicular traffic.

16. Increased efforts to improve the design of the vehicle to make the vehicle easier to operate safely and to minimize the accident and injury potential for occupants and pedestrians.

17. Adoption by all states of legislation and regulations setting up requirements for warning signals for emergency vehicles, school buses, and road maintenance equipment, conforming to the latest revision of the Uniform Vehicle Code.

Long-range Needs

1. Keep current a continuing road inventory and needs study based on standards commensurate with traffic needs and good safety characteristics.

2. Promote well balanced highway programs and give equal consideration to the various elements of various classifications of highways. Adequate funds should be established to properly maintain new highway facilities. Good maintenance on many existing highways can be materially improved to provide additional safety.

3. Long-range planning is essential to the highway program. Planners should give strong consideration to the potentials of stage construction. Well thought out plans will permit early improvements to sit into a long-range program.

4. Better coordination between the vehicle designers, highway designers and those responsbile for traffic operations must be achieved if our highway transportation system is to work smoothly and efficiently.

5. Full advantage needs to be taken of the work of the National Committee on Urban Transportation. The planning aspect of urban transportation has fallen far behind the rural phase, and the plans and work of this committee represent a much needed step.

6. Continued attention needs to be given the subject of traffic operations in highway departments and city government. The trend toward properly positioned city departments dealing with this problem should be encouraged, and a similar development within State government may be expected.

7. Improve engineering school curricula for training highway and traffic engineers in order that the supply of such trained personnel may be in proportion to the highway program and needs in the future.

Opportunities for Public Support

Public support must be developed for a sound long-range engineering program toward correcting the basic causes of accidents. Such a program will be complex, reaching into the fields of driver development and improved technological developments in the road, in traffic management and in the vehicle.

1. Public support is essential for the acceptance of high standards of highway design to the end that safety and longer service may be achieved.

2. Access control on major routes must be understood and accepted by the public as a necessity to safe movement and protection of public investment.

3. Public support of high standards of maintenance on both new and existing facilities is a continuing need. The demands on the budget for maintenance of new facilities and the necessity for continued improvement of existing street systems will require increased expenditures. The necessity for these increased expenditures should be understood by the public.

4. Public support is needed for the operational controls that must be applied on a uniform basis and are necessary not only on new but also to an increasing degree on existing roadways.

5. Public support is needed in expediting the current highway construction program.

6. Favorable public opinion must be crystalized on the problems of metropolitan areas, with particular recognition of the regional character of the traffic problem.

Federal and state highway officials were guests of United States Steel when "Jonah and the Highway," the Corporation's new wide-screen movie dedicated to highway engineers, was shown in Pittsburgh, Pa., for the first time. Seen examining a lobby display at the J. P. Harris Theatre with their host, Richard F. Sentner (far left), U. S. Steel executive vice president-commercial, they are (left to right) C. D. Curtiss, Commissioner of the U. S. Bureau of Public Roads; Eric L. Erickson, Chief of the Bridge Design Division of the U. S. Bureau of Public Roads; L. J. Curran, Pittsburgh District Engineer, Pennsylvania Department of Highways; and Robert A. Farley, Pennsylvania Deputy Secretary of Highways for Engineering.

Killian, 13 Others To Sponsor National Engineers' Week

Fourteen leading engineering figures will act as sponsors for the 1958 National Engineers' Week, February 16-22.

The list of sponsors was announced by John L. Bahr, national chairman of the annual observance held each year during Washington's birthday week under the general sponsorship of the National Society of Professional Engineers.

The fourteen individual sponsors are: James R. Killian, Jr., president, MIT, and newly appointed special assitant to President Eisenhower for science and technology; Allen B. DuMont, chairman of the board, Allen B. DuMont Laboratories, Inc.; Major General Emerson C. Itschner, chief of engineers, United States Army; Charles F. Kettering, General Motors Corporation; Clarence H. Linder, vice president, General Electric Company; Thomas E. Murray, consultant, Joint Committee on Atomic Energy; Granville M. Read, chief engineer, E. I. du Pont de Nemours and Company; Rear Admiral H. G. Rickover, chief of naval reactors, United States Atomic Energy Commission; Royal W. Sorensen, California Institute of Technology; Philip Sporn, president, American Gas and Electric Company; David B. Steinman, consulting engineer; Bertram D. Tallamy, Federal Highway Administrator; Charles Allen Thomas, president, Monsanto Chemical Company; and Robert E. Wilson, chairman of the board, Standard Oil Company of Indiana.

TE Seminar Announced for March At Northwestern

Traffic engineers from all sections of the country will meet in Evanston, Ill., for a three-week seminar March 3-21, 1958.

Offered by the Traffic Institute of Northwestern University, the seminar will stress better methods of traffic research, control, and planning in the light of rising traffic volumes and the new roadbuilding programs. A joint sponsor is the Midwest Section of the Institute of Traffic Engineers.

George W. Barton, director of traffic engineering for the Traffic Institute, emphasized the seminar is designed for personnel with engineering training or experience. He said the course would be most valuable for junior traffic engineers, city engineers with traffic engineering responsibilities, and personnel who are working on a professional level in related fields.

Three main subject-areas will be covered in the seminar:

—Methods of research and analysis: gathering better data about the current street and highway traffic situation.

—Techniques of control and regulation: ways of making the best of existing facilities, such as one-way traffic systems, signalization, vehicle loading facilities, and curb parking regulation.

—Planning for future growth: elements of city planning, highway planning and design, planning for public transit, and design of parking facilities.

Barton said the seminar will consist of lectures and demonstrations by specialists from a number of engineering agencies throughout the country. In addition there will be discussions, laboratory work problems, and field trips.

Engineers who will benefit most from the training, according to Barton, are the following:

—City engineers, or their assistants, from cities not having full-time traffic engineering departments, and where traffic is handled incidentally by the police department, the city engineer's office, or not at all.

—Personnel from traffic engineering offices whose knowledge and experience may be limited because of specialization.

Tuition is $165. Applicants should meet one or more of the following entrance requirements: (1) an engineering degree from a recognized college or university, or engineering experience on a professional level, (2) current employment on a professional level in a traffic engineering office or organization, (3) employment in a department of public works or as a city engineer with traffic responsibilities.

Application should be made to the director of training, Traffic Institute of Northwestern University, 1804 Hinman Ave., Evanston, Ill.

New Appointments

Conradt Enters Consulting Field

Robert Conradt (Assoc. Mem., ITE) has joined the staff of DeLeuw, Cather and Company, San Francisco office. Initially he worked on a study in Sonoma County (Calif.) but lately has been active on projects in Salt Lake City and Las Vegas.

Robert Conradt

Conradt was Assistant Traffic and Safety Director for the New Mexico Highway Department prior to joining DeLeuw, Cather. He had held this position since 1952. Earlier he had worked in other capacities for the department.

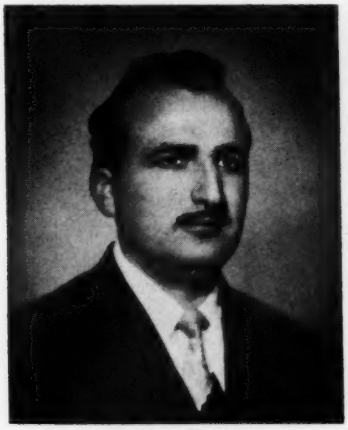
A graduate of the California Institute of Technology, Conradt also studied at Stanford and in 1954 completed the Yale Bureau course. He is a registered professional engineer in New Mexico.

During World War II, he served with the Navy for three years, holding the rank of Ensign when he left the service.

Karnig Moves from Turkey to Canada

Barkev Karnig (Assoc. Mem., ITE) has been named acting traffic signal engineer for the traffic section of the Ontario Department of Highways.

Karnig came to Canada this year from Turkey, where he had been chief of the traffic operations division of the General Directorate of Highways in Ankara since 1951. Earlier he had been in the planning department. Before his government service he had worked for private construction firms.



Barkev Karnig

A graduate in civil engineering from Robert College, Karnig has been recognized as a professional engineer by the Ontario Association of Professional Engineers.

Born in Turkey, Karnig completed his high school course in Frankfort, Germany in 1939. He became a member of the Institute in June while still in Turkey.

Frieling Opens LA Office For Wilbur Smith Firm

Gerald H. Frieling (Mem., ITE) has joined the firm of Wilbur Smith and Associates, in charge of the newly opened Los Angeles office.

Prior to his present engagement, Frieling was with Ebasco Services as a consultant. He spent nearly a year in Australia as Consulting Engineer on Transport Operations to the government of New South Wales.

G. H. Frieling

Frieling was with the Kansas City Public Service Company prior to joining the Ebasco staff. Starting with this company immediately after graduation from the University of Michigan in 1926, he organized the Research Department in 1942 and in 1947 was elected vice president in charge of transportation.

In addition to his membership in the Institute, Frieling is a member of the American Society of Civil Engineers and the American Society of Planning Officials. He is a registered professional engineer in Missouri.

Promotions

James K. Gibson—to Principal Transportation Engineer, California Pub-Utilities Commission.

L. J. Ross—to Chief Design Engineer, Idaho Department of Highways.

Lawrence E. Thompson—to Traffic Engineer, Arizona Highway Department.

Congratulations

To Commissioner C. D. Curtiss (Hon. Mem.) on winning the Bartlett Award.

Research Psychologist Joins NSC Staff

John J. Flaherty has joined the staff of the National Safety Council as director of the Research Division.

Mr. Flaherty's combined background of psychology and engineering, plus additional training in the medical-biological and educational fields provides him with great scope for this work.

Mr. Flaherty comes to the Council from an assignment which has included the design and supervision of research programs to determine such things as validity and reliability of psychological tests, indicators of accident proneness through the study of personnel records and test protocols, assessment of attitudes and morale, and methods of more effective teaching.

As director of the Council's Research Division, Mr. Flaherty will continue with the special work which was started in 1956, the broad objectives of which are to:

1. Collect information about research work in progress in safety and closely related fields;

2. Assemble, collate, analyze, and distribute information on completed research projects;

3. Encourage the prompt publication of work as it is finished;

4. Collect and develop ideas and proposals for new investigations;

5. Find agencies and means for carrying out meritorious investigations;

6. Encourage and assist investigations by the Council staff in fields with which it has unique potentialities.

New Publications

Economic Impact of Highway Improvement.
Special Report 28, Highway Research Board, 2101 Constitution Ave., Washington 25, D.C. 88 pp. 1957. $2.80.

A conference was held in March 1957 at the suggestion of AASHO, bringing together some 40 urban planners, engineers, economists, sociologists, lawyers, geographers, and others who have been studying the effects of improved highways on land values, patterns of land use, and economic activity. This publication is a condensed version of reports made by participants, together with summaries of the discussions.

Automobile Facts and Figures.
37th Edition. Automobile Manufacturers Association, New Center Building, Detroit 2, Mich. 1957. 80 pp.

The annual fact book of the automobile industry, with many useful figures on production and use of motor vehicles.

The Eyes Have It.
By Harold L. Smith, John J. Cummings and Reuel A. Sherman. Ford Motor Co., Dearborn, Michigan. 1957. 12 pp.

The authors present their thesis that correct seeing habits are vital to safer traffic operation, and that these habits, once identified, can be learned.

The techniques suggested will be of interest to all who drive, but also to all who have an interest in or responsibility for the safety of motor vehicle traffic.

Strictly Business

Multi-Message Signs Devised for Lincoln Tunnel

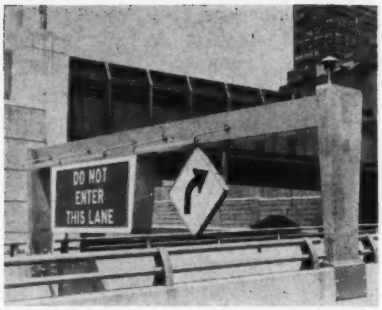
When the Port of New York Authority opened the third tube of the Lincoln Tunnel under the Hudson River, engineers were faced with severe signing problems.

The new traffic pattern calls for vehicles to move west from New York to New Jersey through the north tube. The south tube takes traffic east into New York, while the center tube, under ordinary conditions, carries one lane in each direction. At peak hours, both lanes of the center tube speed vehicles in the direction of the major traffic flow.

At the heart of the control system, which must stop and reverse vehicular movement in the center tube, are 77 porcelain enamel on aluminum signs. Constructed of sheet supplied by Aluminum Company of America, the signs range in size from 2-ft by 2-ft, to huge 6-ft by 18-ft over-lane structures. They are supported by columns and trusses fabricated of Alcoa aluminum plate, channels, tubing and pipe. Most of the sign faces, constructed and porcelain-enameld by Mulholland-Harper Co., Philadelphia, carry one or two directional messages.

But the keystones of the system are five multi-message Alcoa aluminum signs located at the tunnel approach roadways. Each carries three messages that appear in turn at a cut-out in the sign face.

The three lines of copy composing a message are marked separately on small aluminum panels. An electrically operated gear system propels the panels around the inside of the aluminum signs. The text tells a motorist approaching the center tube the direction of traffic flow in each lane of the roadway. Controls for the unusual multi-message signs are located at a central console, and at each installation site. According to The Port Authority, the three-message signs greatly reduce man-hour requirements for handling the heavy tunnel traffic.

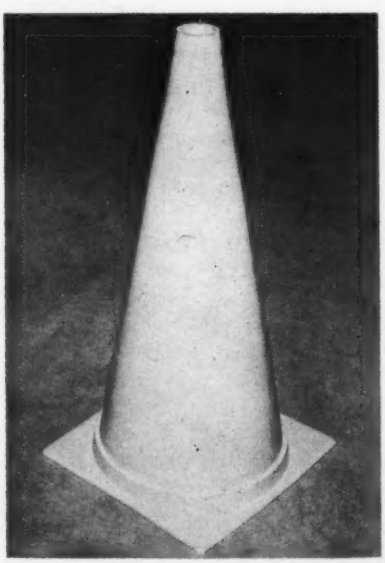


One of the multi-message signs installed on the approach roadways of the Lincoln Tunnel. Each sign carries three messages that appear in turn at a cut-out in the sign face. The message is changed by a system of electrically operated gears controlled at a central console.

Erected by general contractor Anderson-Laudadio, New York, and fabricated by C. Frederick Wolfe, the installation represents a decision by The Port Authority based on 12 years experience with porcelain-enameled aluminum signs. Used originally because of their light weight, corrosion-resistant aluminum signs have demonstrated long service life with low maintenance costs.

New "Full-Color" Safe-T-Cones Announced

A new Safe-T-Cone Traffic Guide is now in production at Radiator Specialty Company in Charlotte, North Carolina.



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Brilliant color is "kneaded" right into the basic components of these durable traffic markers, making them "full-color" for life . . . without peeling or cracking of paint . . . never need repainting. Traffic film, dirt and grime can simply be washed off with soap and water.

Known as Poly-Cones, these new road markers are specially molded of Poly-viny chloride, a tough, plastic-type substance that remains pliable, yet is nearly twice as durable as rubber cones. They will not crack or tear even when run over by the heaviest trucks or buses, it is reported.

They are available either all yellow or with brilliant fluorescent color for extra visibility.

These new cones are specially designed to "nest" together, taking up less storage space. Special design in top of cone enables it to hold a standard Safe-T-Sign, Flasher-Light or Flag Adaptor.

Safe-T-Cones are now in use all over America, for directing traffic, line painting emergency barricades and traffic channeling, as well as by industrial plants, parking lots, public utility companies and schools.

Letter to Editor

October 31, 1957

Dear Editor:

In Cleveland they cut them close. This is our "house by the side of the road"—and I do mean "side."

ROBERT J. KELLY
Traffic Engineering & Parking Div.
Cleveland, Ohio

Michael J. Gittens, Pittsburgh's Traffic Engineer, examines the moisture test for glass beads in Prismo's laboratory in Huntingdon. The spheres shown in the funnel are not moisture proof. Moisture-proof spheres will flow through the funnel even when immersed in water.

Wald Industries gives a sneak preview of their new "Town and Country" self-contained striping unit. Mounted on a cab-forward Jeep chassis, it is extremely maneuverable. Controls are electric—the driver can choose his type of line or lines by pushing a button.

Training Opportunities

January 22-24 — NORTHWEST TRAFFIC ENGINEERING CONFERENCE—

The 11th annual conference, sponsored by Oregon State College and the Oregon State Highway Department. Held at Oregon State College, Corvallis. Contact: Martin P. Coopey, Professor of CE, OSC, Corvallis, Ore. for further information.

February 27-28—10th ANNUAL ILLINOIS TRAFFIC ENGINEERING CONFERENCE—

For further information, address: Professor John E. Baerwald, 401 Civil Engineering Hall, Urbana, Ill.

March 3-21—TRAFFIC ENGINEERING SEMINAR

Sponsored by Northwestern University Traffic Institute and the Midwest Section, ITE. For traffic engineers and others with engineering backgrounds. Tuition $165. For information, address: Northwestern University Traffic Institute, 1704 Judson Ave., Evanston, Ill.

March 17-21 — 3rd ANNUAL SHORT SCHOOL ON TRAFFIC ENGINEERING —

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Coming Events

January 20-23 — AMERICAN ROAD BUILDERS ASSOCIATION—
Annual Convention, Sheraton Park Hotel, Washington, D.C. Contact: ARBA, 600 World Center Bldg., Washington 6, D.C.

February 13-15—NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS—
Spring Meeting, Michigan State University, East Lansing, Michigan. Contact: NSPE, 2029 K St. N.W., Washington 6, D.C.

February 24-28 — AMERICAN SOCIETY OF CIVIL ENGINEERS—
Convention, Sherman Hotel, Chicago, Ill. Contact: ASCE, 29 W. 39th St., N.Y.C.

March 2-4 — SOUTHERN SAFETY CONFERENCE & EXPOSITION—
Peabody Hotel, Memphis, Tenn. Contact: W. L. Groth, P.O. Box 8927, Richmond 25, Va.

March 17-19 — WESTERN SAFETY CONGRESS & EXHIBITS —
9th Annual Meeting, Ambassador Hotel, Los Angeles, Calif. Contact: Joseph M. Kaplan, 3388 W. 8th Street, Los Angeles 5, Calif.

March 23-29—AMERICAN CONGRESS ON SURVEYING & MAPPING—AMERICAN SOCIETY OF PHOTOGRAMMETRY—
Consecutive Meetings & Exhibit, Shoreham Hotel, Washington, D.C. Contact: ACSM-ASP, 1515 Massachusetts Ave. N.W., Washington 5, D.C.

April 14-17 — GREATER NEW YORK SAFETY COUNCIL CONVENTION —
Statler Hotel, New York, N. Y. Contact: Greater N. Y. Safety Council, 60 E. 42nd St., N.Y.C.

May 18-22—AMERICAN SOCIETY OF PLANNING OFFICIALS—
Annual Conference, Hotel Statler, Washington, D.C. Contact: Dennis O'Harrow, ASPO, 1313 E. 60th St., Chicago 37, Ill.

August 17-22 — ILLUMINATING ENGINEERING SOCIETY—
National Technical Conference, Toronto, Ont. Contact: IES, 1860 Broadway, N. Y. 23, N.Y.

September 14-19 — AMERICAN ASSOCIATION OF MOTOR VEHICLE ADMINISTRATORS —
Annual Meeting, Fairmount Hotel, San Francisco, Calif. Contact: AAMVA, 912 Barr Bldg., Washington 6, D.C.

September 16-20 — FOURTH INTERNATIONAL STUDY WEEK IN TRAFFIC ENGINEERING—
Copenhagen, Denmark. Contact: World Touring and Automobile Organization, 32 Chesham Place, London, SW1, England.

September 28 - October 1 — AMERICAN PUBLIC WORKS ASSOCIATION—
Muehlebach Hotel, Kansas City, Mo. Contact: APWA, 1313 E. 60th St., Chicago, Ill.

October 12-17 — AMERICAN TRANSIT ASSOCIATION—
Roosevelt Hotel, New Orleans, La. Contact: ATA, 292 Madison Ave., N.Y.C.

October 13-17 — AMERICAN SOCIETY OF CIVIL ENGINEERS—
National Convention, New York City. Contact: ASCE, 29 W. 39th St., N.Y.C.

October 20-23 — INTERNATIONAL MUNICIPAL SIGNAL ASSOCIATION—
Sheraton Hotel, Philadelphia, Pa. Contact: IMSA, 130 W. 42nd St., N.Y.C.

October 20-24—NATIONAL SAFETY CONGRESS
Conrad Hilton, Congress and other hotels, Chicago, Ill. Contact: NSC, 425 N. Michigan Ave., Chicago 11, Ill.

November 10-14 — INSTITUTE OF TRAFFIC ENGINEERS—
28th Annual Meeting, Deauville Hotel, Miami Beach, Florida. Contact: ITE, 2029 K St.,NW, Washington 6, D.C.

November 28-December 5—AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS
Annual Meeting, Sheraton-Palace Hotel, San Francisco, Calif. Contact: AASHO, National Press Bldg., Washington 4, D.C.

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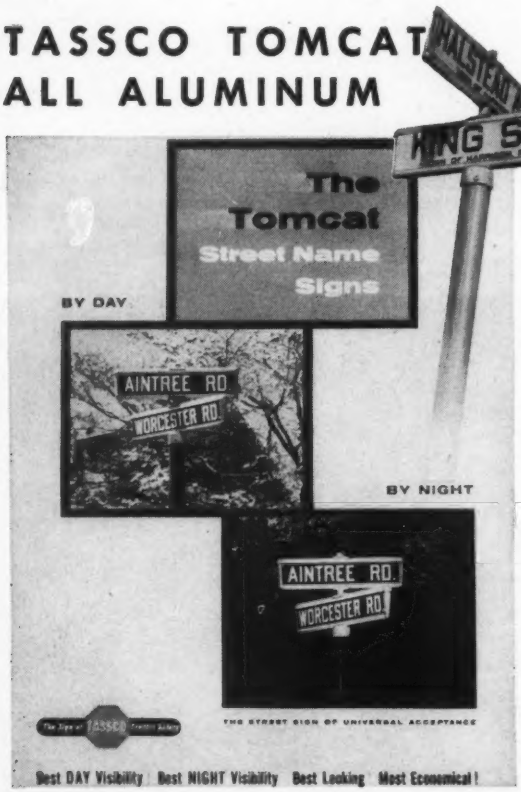

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Reference Notes

GEOMETRIC DESIGN OF LOADING PLATFORMS AND BUS RUNWAYS FOR LOCAL AND SUBURBAN BUS TERMINALS

A report of Technical Committee 6-C of the Institute of Traffic Engineers, approved as an Information Report by the Technical Council and the Board of Direction and authorized for publication.

This report deals with pull-through lanes, accommodating buses in tandem position for loading and unloading passengers. Generally, this type has been found advisable in the interest of safety and speed of operation for local and suburban terminals where service is frequent and passenger handling time is short — in contrast to heading into and backing out of saw-tooth berths as is commonly the practice in the long-haul bus field.

Cooperation Between Interested Parties

Since terminals frequently are built by other than the transportation company or those who will operate bus service at the terminal, too much emphasis cannot be placed on the importance of full cooperation between the planners and designers, on the one hand, and the operating companies, on the other, with respect to platform and runway design.

Once the terminal is built, it must be "lived with" day in and day out by the bus operator and the patrons. Modifications to correct deficiencies may be difficult and expensive if not impossible.

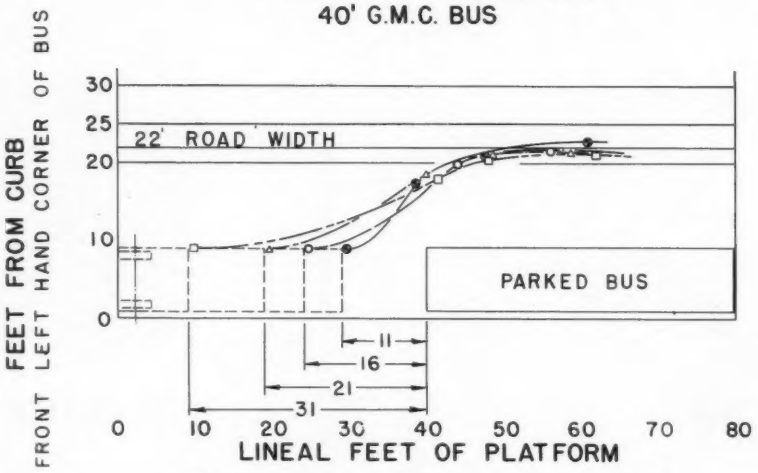
Basic Factors Affecting Design

Some of the basic factors affecting platform and runway design are dictated by the terminal location and overall plan, such as the following:

1. The general bus circulation scheme i.e., straight through the terminal area; in and out on a 90° turn; in and out the same end, involving a 180° or U turn.

2. The provision of adequate holding-area space for marshalling empty equipment for proper feed-in.

CURVES SHOWING REQUIRED ROAD WIDTHS AND BERTH LENGTHS AT SELECTED PULL OUT DISTANCES
40' G.M.C. BUS



PULL OUT DISTANCE	ROAD WIDTH	BERTH LENGTH
11'	23'	51'
16'	22	56'
21'	21'-8"	61'
31'	21'	71'

—Courtesy Port of New York Authority

Figure 1

3. Whether unloading and loading is handled on the same or separate platforms.

4. Whether bus runways are single or double lane.

5. Whether the terminal is a one-level design or two-level design with passenger access by stairway to and from the platforms.

Bus Runways

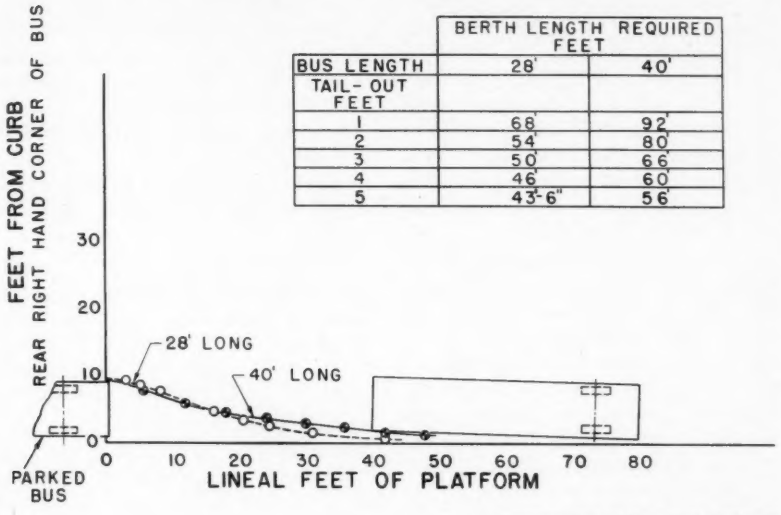
Widths—10-foot wide single lanes will suffice for 8-foot wide equipment. (9'-6" lanes have been "forced" in some instances because of space restrictions.) 11-foot lanes are preferable where ample terminal space is available and especially to accommodate equipment over 8 feet wide, the use of which steadily is increasing.

Double lane runways, enabling standing buses to be overtaken by other buses, provide a great advantage over one-lane runways, because of the increased flexibility of operations that is made possible. This matter of flexibility becomes increasingly important (1) where departure headways are short, (2) where different bus companies or more than one route operate off a common platform, and (3) where the terminal layout requires loading platforms to be relatively long. Unloading runways usually must be 2-lanes wide to enable empty or lightly loaded buses to proceed past a heavily loaded bus. This is of prime importance where, as is often the case, the unloading runway is also the only terminal entrance runway.

For the purpose of merely overtaking another bus or row of buses, having no appreciable tail-out, double-lane runway widths should be at least 20 feet and preferably 22 feet, especially if extra-wide equipment is to

CURVES SHOWING REQUIRED BERTH LENGTHS
AS COMPARED TO BUS TAIL-OUT
28' AND 40' G. M. C. BUSES

BUS LENGTH TAIL-OUT FEET	BERTH LENGTH REQUIRED FEET 28'	40'
1	68'	92'
2	54'	80'
3	50'	66'
4	46'	60'
5	43'-6"	56'



—Courtesy Port of New York Authority

Figure 2

be accommodated—immediately or in the future. However, for a flexible operation under which departing buses may pull out from the platform around a standing bus, the runway width and the amount of lineal space at the platform for the pull-out maneuver are directly related. This relationship is indicated by Figure 1, from which it is seen, for example, that a 40-foot bus having a 16-foot clearance ahead, actually uses 22 feet of runway width for the pull-out. This would indicate for practical purposes, a runway width of at least 24 feet. Also, a total minimum berth length of 40 feet plus 16 feet or 56 feet would be required. Obviously, the shorter the berth length allowed, the wider the runway must be, and vice versa.

Additional Clearances and Widths—Bus turning movements at runway entrances and exits require additional width and the radii at such points should be sufficiently long to permit equipment to operate without extremely sharp turns. In this aspect of design, actual swept-paths of equipment to be operated should be determined by careful tests and an additional clearance should be provided to allow for variations in driver performance and vehicle characteristics in every day operations.

Ramping—Where roadway ramping, down or up, at entrances or exits to runways is necessary, care should be taken to avoid sharp grade changes which will result in discomfort to passengers or rough treatment of equipment, particularly when heavily loaded. Here again, where this factor is involved, tests should be made with buses, and allowance made for possible future vehicles having a longer wheel base and overhang.

Headroom and Side Clearance in Terminal Building—Where buses are to enter terminal buildings, doorways and other structures should allow sufficient side clearance to permit free movement of vehicles and to avoid damage and delay. Door headroom should be at least 12′ for typical equipment, allowance being made for any use of the terminal by deck-and-a-half or double-deck buses. Actual dimensions of equipment to use the terminal should be checked before fixing critical dimensions. Minimum side clearance to all structures along the runway should be at least 12 inches.

Unloading Platforms

Separate unloading and loading platform areas are preferable — and generally are required — where frequency of bus arrivals and departures and number of accumulated patrons is anything but a minimum. For safety and convenience, unloading platform areas elevated 5″ to 8″ are preferable.

Unloading Platform Capacity—Unloading platform area, insofar as the discharging passengers are concerned. need only be adequate to accommodate their free movement to the point or points of exit. Width should be sufficient to permit free circulation past the exit door of unloading buses where momentary accumulation of a few passengers may take place. Exit locations in a high-capacity terminal should be balanced in location to minimize walking distance and conflicting movements under peak-hour conditions.

The principal capacity requirement of an unloading platform is in terms of required number of berths for the operations involved. One important factor is whether or not one or more bus routes or bus companies use the facility. If several lines or if different type services are involved, total length should be sufficient to permit a bus to stop with sufficient pull-out space behind the bus ahead (See Figure 1). Normally, arriving buses may stop in turn behind the preceding bus at the platform, wherever that point may be (as contrasted with designated berths for loading certain buses on a loading platform). Considerable lineal space is necessary to permit a bus to overtake and pull in to a platform ahead of a standing bus. Figure 2 shows the extent of this space requirement in terms of tail-out at the stopping point. For example, a 40-foot bus uses 80 feet to pull in, leaving the rear end still 2 feet out from the platform curb. Thus, for any runway where such maneuvers are to be permitted, tail-out distance should be considered in determining the width to assure adequate safe clearance for vehicles in the outside or overtaking lane. And further, if a considerable number of empty (run-on, tripper, gap-filler) buses will enter the terminal, having no need to stop at the unloading platform, a separate lane protected from the unloading runway maneuvers by a physical divider, should be provided.

A second important factor is whether or not any buses are to be allowed to stand or lay over empty at the unloading platform as a holding area, in lieu of proceeding to the loading platform, or to a separate holding area, or directly out of the terminal. Generally, such layover cannot be permitted except with the smallest of operations.

In estimating the unloading berth space requirement, careful analysis of both scheduled and actual bus arrivals and passenger loads and unloading times, during the peak periods of all services involved is essential.

Table A gives an indication of passenger unloading headways for local or suburban operations for the conditions specified.

TABLE A
Approximate Passenger Unloading Headways, In Seconds

*Very little hand baggage and parcels, few transfers	1½-2½
Moderate amount of hand baggage or many transfers	2½-4
Considerable amount of baggage, from racks	4-6

*Typical weekday rushhour riding to and from work.

A bus load of 50 passengers leaving the bus on a 2-second headway, would require less than 2 minutes to unload. Thus, for example, if similar bus loads arrived on a 2-minute headway, theoretically one berth would be adequate. However, in practice, schedule or running time variations would make 2 berths necessary even under good operating conditions.

Loading Platforms

Loading platform space and arrangement is of major importance. In fact it generally is the most critical feature in terminal operation where rushhour conditions prevail. Separate loading spaces for different main routes or destinations should be provided.

For low-cost or temporary terminal layouts, passenger loading spaces and bus lanes or runways satisfactorily may be on one continuous flat surface. Minimum control and guidance requires marked areas for passengers, preferably with stanchions and chains or railings.

For important or permanent installations, raised loading platforms are preferable, (1) to better define passenger and vehicle spaces (2) to provide dryer, cleaner surface on which to stand, and (3) to provide greater convenience and safety in stepping into or out of vehicles. Curb exposures of 5 to 8 inches are usually satisfactory. If higher platforms are to be considered, door step heights on the types of vehicles to use the terminal should be checked. Passenger access at the ends of raised platforms (in one-level terminals) should be ramped on a slope of approximately 12 to 1 in preference to an abrupt step-up.

Protection from Passing Buses—In multiple lane terminals, passenger protection requires a guard railing or fencing along the back edge of the platform adjacent to the next vehicle lane. Such barrier should have a minimum clearance of 12 inches from the runway. Also, the bottom portion of the fence or railing should be equipped with a continuous shield to protect patrons' clothing from exhaust blast—and, in the case of outdoor terminals, from roadway splash.

Wherever it is at all practicable under the terminal operating conditions, a guardrail should be installed as a safety measure along the front or loading edge of platforms, between bus entrance points. If the buses stop regularly at specific points or if the platform has only one berth, such railing presents no problem. With multiple berth platforms, the loading gaps in the railing should be widened to allow for variations in bus lengths and for bus positioning by the drivers. Removable sections or snap-on chains may solve the problem of adjustments for varying loading conditions.

Platform Canopies — Canopy type shelters over loading areas on open lots are important for the convenience and protection of patrons. They should provide vertical clearance equal to that for terminal doorways, thus allowing the canopies to extend a foot or more over the roof of vehicles for increased protection against rain, etc. Supporting columns should be designed to minimize platform interference.

Loading Queues — For the typical rushhour situation, even for small accumulations of patrons, queuing is necessary (1) to avoid crowding and disorder and (2) to enable high-capacity or maximum use of the space available. Queue positioning should be clearly indicated by signs and chain or piperail barriers. On high-capacity multiple-berth platforms, signing is very important and can eliminate much confusion by marking the starting point for a given queue (usually, the bus loading point) and by indicating to approaching patrons the correct way to a given loading point or queue. Overhead suspended signs are advisable wherever their installation is possible, so as to minimize the number of posts and stanchions on the platform and for increased visibility through adequate elevation.

Queue Layout and Control—In large terminals or wherever a heavy rushhour situation exists with loading space limitation, queue layout or shape becomes important and requires careful study. Once the queue plan for a platform is developed, chain and stanchion barriers should be installed wherever necessary for control purposes. Where several queues must form for various bus routes on one platform, it usually is advantageous for efficient space utilization to "fold" certain queues into a "U" rather than letting them extend in one long continuous line. Platform obstructions may force use of variations in queue shapes. It is important to allow circulation space for the platform starter or supervisor in moving readily from berth to berth, preferably along the front edge of the platform.

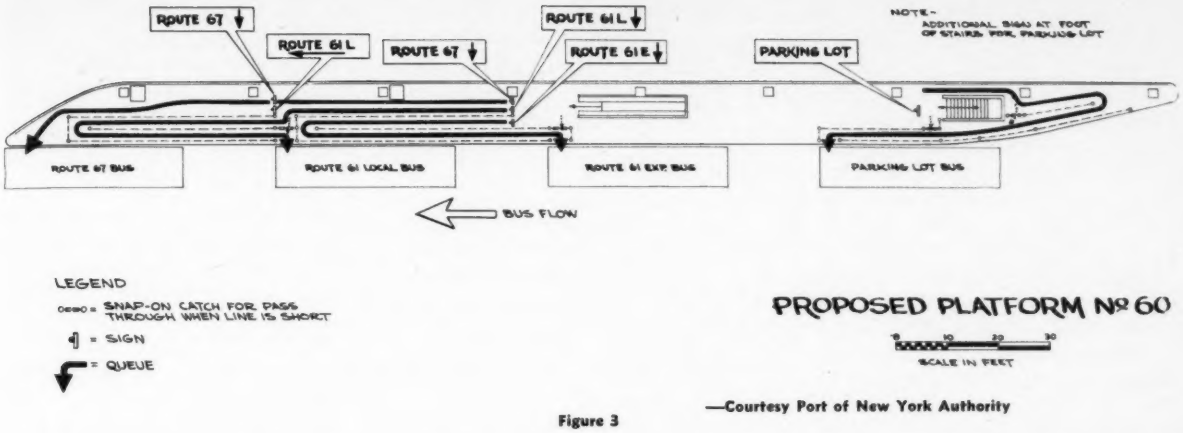
Patrons standing in a queue occupy an average of approximately 1.67 feet of lineal space each, i.e., a queue of 50 patrons will be about 83 feet long.

A single queue can be confined within a space 2′0″ to 2′6″ wide. A double queue will require approximately 3′6″ to 4′0″ between barriers. Non-rigid barriers such as chains or ropes on stanchions may be placed closer together than would be advisable where rigid railings are used. For purposes of flexibility to meet varying conditions, snap-on chain sections between stanchions should be used. Stanchions preferably should be set in sockets imbedded in the platform, although portable stanchions may be used for preliminary testing of queue layouts. Also, consideration should be given to provision in a platform of extra stanchion sockets with flush covers so that barriers may be adjusted for varying or special situations.

The practicability of remote queue or passenger holding area locations also should be explored by the designer, particularly for two-level terminals wherein such areas might be located on the concourse level. This plan would reduce platform area requirements on the bus level, allowing more bus berths, and perhaps afford generous passenger holding space on the concourse level.

Figure 3 shows a platform operating layout, at the Port of New York Authority Bus Terminal, illustrating queue arrangements for a 4-route platform having a double-lane runway.

Access Stairways—In a 2-level terminal where patrons reach their platform by stairways, a thorough study to determine the most advantageous location for stairways should be made. Locations at one end of the platform usually offer less obstruction, particularly if the platform is relatively narrow. Also, such location results in a smoother, one-way flow of patrons



—Courtesy Port of New York Authority

Figure 3

towards the various loading queues or loading points. Stair wells, usually at least 5 to 6 feet wide, constitute a major obstruction laterally on platforms that are 10 feet, 12 feet, or even 15 feet wide. For this reason a center line location offers the advantage of permitting circulation past the well on both sides.

A stairway location at the forward end (bus exit end) of the platform enables arriving patrons readily to see bus destination signs. Where stairs are located at the rear (bus entrance end), some bus operators provide small route number signs which the supervisor hooks into a special bracket, provided on each bus facing the rear towards arriving patrons. If buses, for any given route, regularly use the same loading berth, adequate signing over the platform eliminates the need for the detachable signs and the added chore of handling them.

Stairway locations largely are influenced by the structural framing of a terminal building. For this reason framing design should not be finally adopted until proposed platform layout and operations are thoroughly studied. It may be possible to adjust the framing plan so as to enable improved stair locations.

Loading Capacity Problems Affect Design — The capacity of a terminal should be adequate to depart bus loads of patrons at a rate equal to their arrival during rushhour periods. The platform space must accommodate temporary accumulations of patrons between departing trips. The prime problem then, where more than one route is involved, is (1) to get the various empty buses into loading position *in proper order* as needed and (2) to get them *out when loaded*; all of which is directly related to platform size, shape, and arrangement. Factors involved in estimating platform requirements include:

1. Off-Schedule Arrivals — The extent to which arriving buses vary from on-time performance, both ahead of time and behind time, seriously affects terminal operations. Longer routes usually result in greater variations due to greater exposure to varying traffic conditions. Scheduling should be checked for possible improvements. A most important thing, however, is to study operations to determine what relationship of scheduled arrival times and layover times, between different routes using the same platform, will result in the highest percentage of bus arrivals in their proper order.

By sufficient plotting of actual arrival, loading, and departure times against the scheduled times, and by experimenting with different schedule relationships in this respect, optimum relationships may be determined for the most expeditious handling of peak hour movements.

Communications can be of great assistance in the problem of schedule control as well as the berth assignment of approaching buses. If the terminal or platform supervisor knows ahead of time that trip A, due 2 minutes ahead of trip B, is going to be 5 minutes late, he may be able to take corrective action with a minimum of confusion. Such communication plans vary greatly on various transit properties and indications are that improved, modernized systems are being developed. A good example of such a system, as used by the Montreal Transportation Commission, is diagramed and described in Figure 4. A number of bus fleets equipped with two-way radio are in operation. These related matters di-

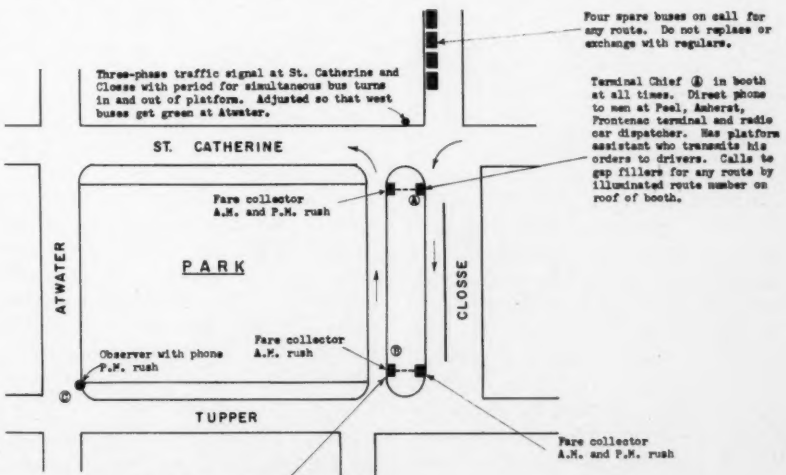

Four spare buses on call for any route. Do not replace or exchange with regulars.
Three-phase traffic signal at St. Catherine and Closse with period for simultaneous bus turns in and out of platform. Adjusted so that west buses get green at Atwater.
Terminal Chief Ⓐ in booth at all times. Direct phone to men at Peel, Amherst, Frontenac terminal and radio car dispatcher. Has platform assistant who transmits his orders to drivers. Calls to gap fillers for any route by illuminated route number on roof of booth.
ST. CATHERINE
Fare collector A.M. and P.M. rush
PARK
ATWATER
CLOSSE
Observer with phone P.M. rush
Fare collector A.M. rush
TUPPER
Fare collector A.M. and P.M. rush
Supervisor Ⓑ in charge of west routes. Direct phone to Ⓐ and to man at Claremont. Has platform assistant. During P.M. rush, receives information from Ⓒ re sequence of arrivals from west. Has control panel to indicate berthing places by illuminated route numbers on platform. Ⓑ also controls sign on roof of booth telling drivers where to proceed into platform during rush.

FIGURE 4

EXAMPLE OF COMMUNICATION & SIGNALING SYSTEM TO CONTROL BERTHING OF BUSES AND TO CALL IN STANDBY GAP-FILLERS

Courtesy Montreal Transportation Commission

rectly affect the design and capacity requirements of terminal loading facilities.

2. Holding Lot—For rushhour movements of any consequence, provision should be made for a bus holding lot or area adjacent to the loading area where empty equipment may be held momentarily or a few minutes, until its turn comes up for feeding into the loading runway. For large terminals and heavy movements, a holding area is imperative. Studies mentioned in No. 1 above will help in estimating the minimum number of holding area bus spaces required to satisfactorily take care of actual operating conditions. Undue congestion and delay, both internally and on surrounding streets, occurs at numerous terminals because of inadequate holding areas.

3. Passenger Volume and Loading Characteristics — Studies indicate a substantially consistent pattern in arrival times at terminals of home-bound commuters. Passenger boarding headways depend on the type of service, fare collection system, amounts of fare, transfers, etc. Table B gives headway data for the conditions specified. All those matters should be studied before determining platform requirements.

Table C illustrates the number of berth spaces required to be available for varying bus headways, passenger loading headways, and number of passengers per bus.

TABLE B

APPROXIMATE PASSENGER LOADING HEADWAYS
LOCAL - SUBURBAN BUSES

Fare Collection	Headway Seconds
Single coin or token — fare box	2 to 3
Odd-penny cash fares	3 to 4
Multiple-zone fares (prepurchased tickets) including registration by driver*	4 to 6
Multiple-zone fares (cash) including registration by driver	6 to 8

*Ringing up on register, the origin and destination zone numbers and amount and type of fare collected and issuance of register receipt to each passenger.

Note: These headways would be extended by any considerable amount of hand baggage.

TABLE C

NUMBER OF AVAILABLE BUS POSITIONS REQUIRED
FOR GIVEN SCHEDULE AND PASSENGER LOADING CONDITIONS

Scheduled Bus Headway Minutes	Passenger Loading Headway								
	3 Seconds Passengers Per Bus			5 Seconds Passengers Per Bus			7 Seconds Passengers Per Bus		
	30	45	60	30	45	60	30	45	60
2	1	2	2	2	2	3	2	3	4
5	1	1	1	1	1	1	1	2	2
10	1	1	1	1	1	1	1	1	1

General Layout

On the basis of studies indicated above, as well as many others according to the particular problems of the project involved, the general layout or arrangement and size of loading platform and runways should be determined.

For a simple one-route operation, all bus berths generally can be on one platform regardless of length required. However, where several bus routes are involved, experience indicates that the number of routes or different type services assigned to one platform should be held to the lowest possible minimum—not more than two or three if at all possible. For example, if a total of 8 berths are required for a terminal accommodating 8 different routes, four 2-berth platforms handling two routes each can be operated more efficiently than two 4-berth platforms handling 4 routes each.

While loading platform widths for small simple operations may be as narrow as 5 or 6 feet, platforms requiring substantial queueing of accumulated passengers and involving considerable circulation should be at least 12 feet wide. Major or numerous obstructions on the platform may require greater platform width.

Cost vs. Peak Use—The basic problem of terminal cost vs. extent or manner of use faces the designer with respect to overall layout and especially peak capacity accommodations. Greater cost may be justified for amply meeting maximum needs where the facility will be used at relatively high capacity for a substantial part of each day. If, on the other hand, peak rushhour use lasts only one or two hours with possibly as little as 10 per cent to 15 per cent of capacity utilized during the balance of the day, economy may dictate a less elaborate design with less allowance for extreme peaks. Here, especially, the designer should plan loading facilities and arrangements which lend themselves to the highest efficiency in operations.

Future Expansion—Wherever need for future expansion of the terminal's capacity is anticipated, that need should be considered in the original geometric design to assure its future accomplishment in the most practicable and economical manner.

Appendices

Some Examples of Terminal Layouts

Appendix No. 1—Illustrates a small, simple terminal arrangement in conjunction with an offstreet turn loop. Note separate unloading and loading points and adequate space for holding a bus, if necessary, while others proceed into or out of the loop.

Appendix No. 2—Shows a terminal for a suburban service where limited property available forced use of narrow runways, platforms, and waiting room. A special feature of this terminal's usage is that it has only a short, sharp, P.M. peak for loading. The A.M. rushhour commuters are discharged at a subway station a mile away from the terminal.

Appendix No. 3—Illustrates a fairly substantial terminal facility incorporated in a major street, making use of a center mall area for bus runways and protected loading platforms, in addition to the adjacent curb lane and sidewalk area. Note segregated loading areas for various services.

Appendix No. 4A—Shows the suburban passenger concourse and the suburban bus level, located above, of the multi-level Port Authority Bus Terminal in New York City. Suburban buses enter and leave via elevated

ramps and have a common unloading platform with double-lane runway and island loading platforms—mostly with single-lane runways. Both moving and stationary stairs provide access between the concourse and the loading islands.

This is the world's largest bus terminal and, on the suburban level during the peak one hour of the P.M. rush, handles as high as approximately 380 bus departures carrying nearly 17,000 passengers. This latter figure may be compared with a peak 24-hour departure of approximately 64,000 passengers from this level. (And with a peak 24-hour departure of approximately 3,900 passengers from the long-distance bus level—See Appendix 4-B.)

Appendix No. 4B—Shows the long distance bus level with saw-tooth berths and also a longitudinal section of the Port Authority Bus Terminal.

Appendix No. 4C — Illustrates the reduced local street travel of suburban buses, resulting from the consolidation of various terminals into the huge Port Authority Bus Terminal.

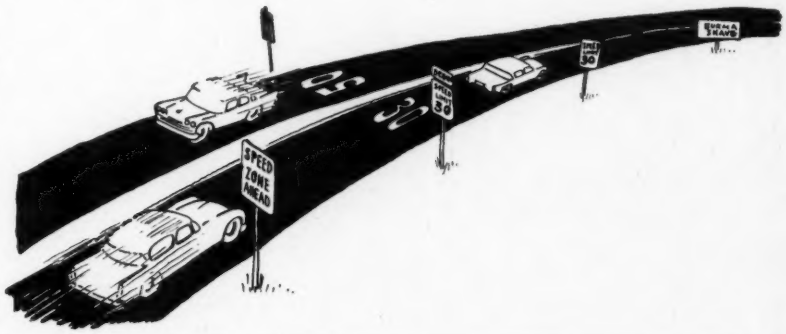
(Appendices are shown below and on following pages)

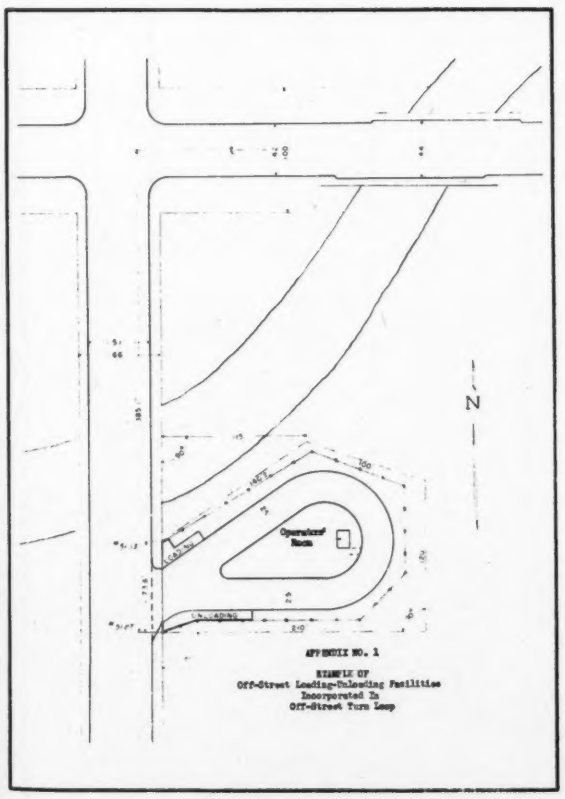
INFORM THE DRIVER

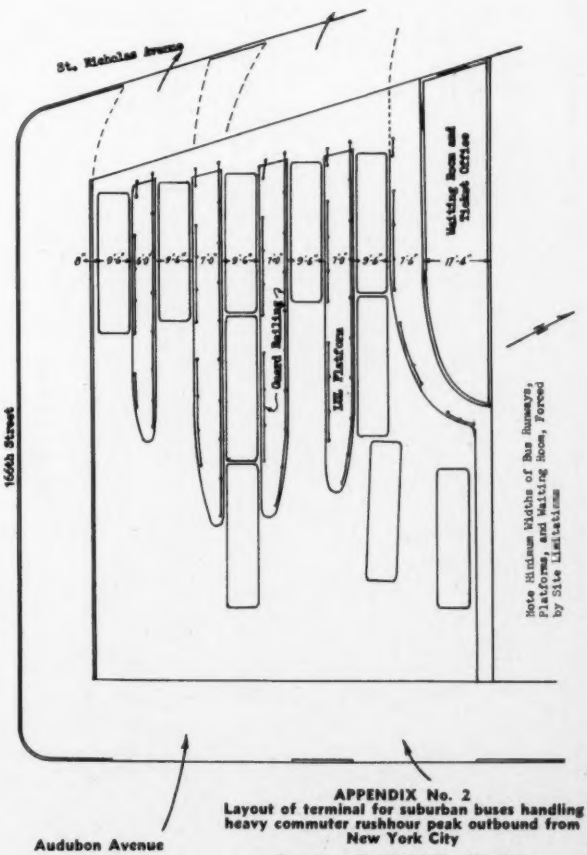
(Continued from page 19)

One hundred sixteen school patrolmen (retired firemen, policemen, etc.), employed and supervised by the Dallas Police Department, are able to do an effective job in safeguarding the lives of the younger generation to and from school. Reasonable speed limitations, both numerically and time of duration, have played a definite part in the general observance by drivers of school zones, and the safety record chalked up has been gratifying (two school child fatalities during the past 15 years).

Again, and in conclusion, Mr. Average Driver is not a willful offender and if speed restrictions are realistic, understood, and the *driver is properly informed*, obedience to regulations will result. Engineers, responsible for posting speed limits, might well be guided by the philosophy of the backwoods preacher who, when asked how he did such a good job in getting his message across to his congregation, answered, "First, ya tells 'em what you're going to tell 'em; then ya tells 'em; and finally ya tells 'em what ya told 'em."



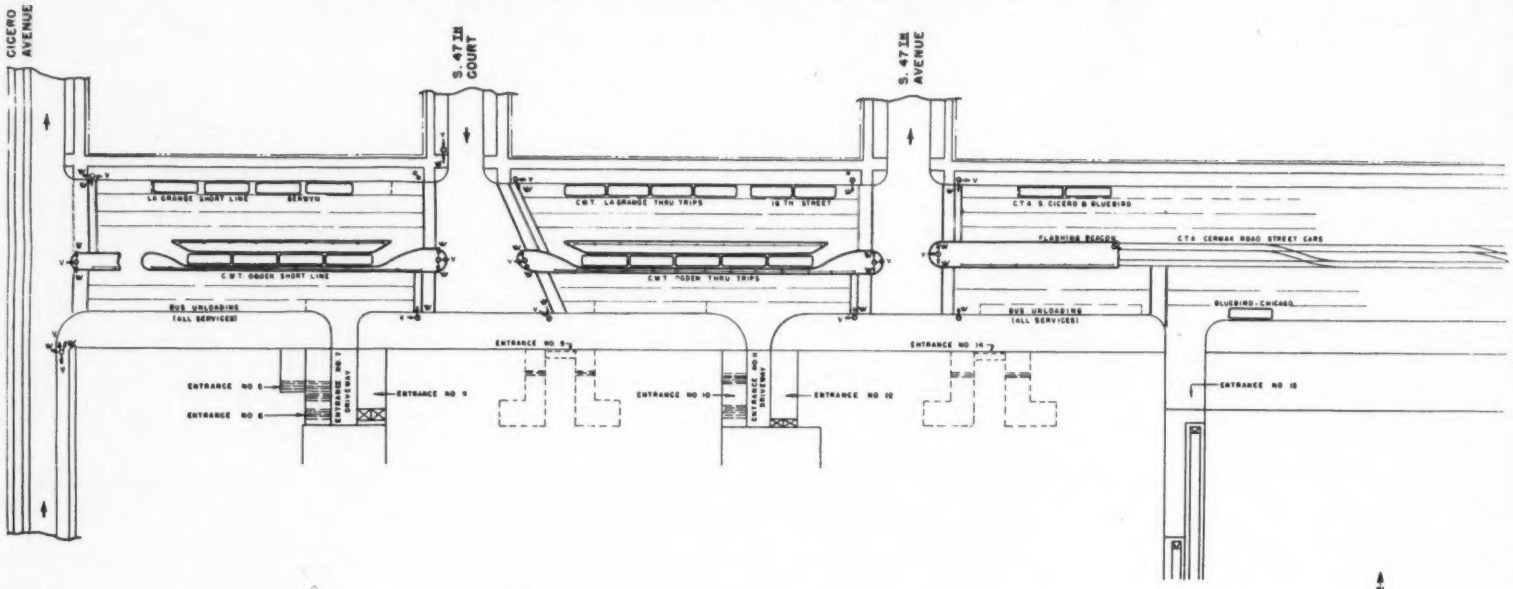


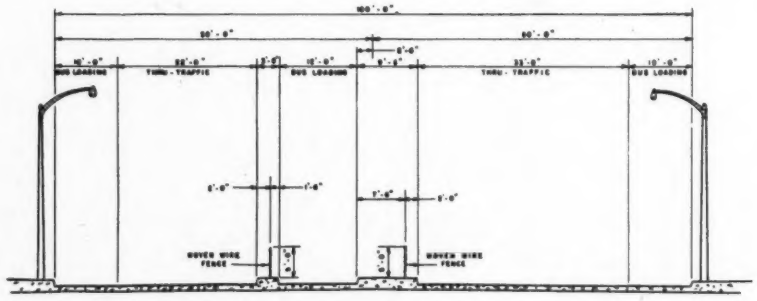

St. Nicholas Avenue
166th Street
Audubon Avenue
Waiting Room and Ticket Office
Guard Railing
12 Platforms
Note Minimum Widths of Bus Runways, Platforms, and Waiting Room, Forced by Site Limitations

APPENDIX No. 2
Layout of terminal for suburban buses handling heavy commuter rushhour peak outbound from New York City
Courtesy—Rockland Coaches, Inc.

APPENDIX NO. 3

EXAMPLE OF ON-STREET LOADING-UNLOADING FACILITIES IN CICERO, ILLINOIS
(Note route segregation for loading) Courtesy - De Leuw, Cather & Company

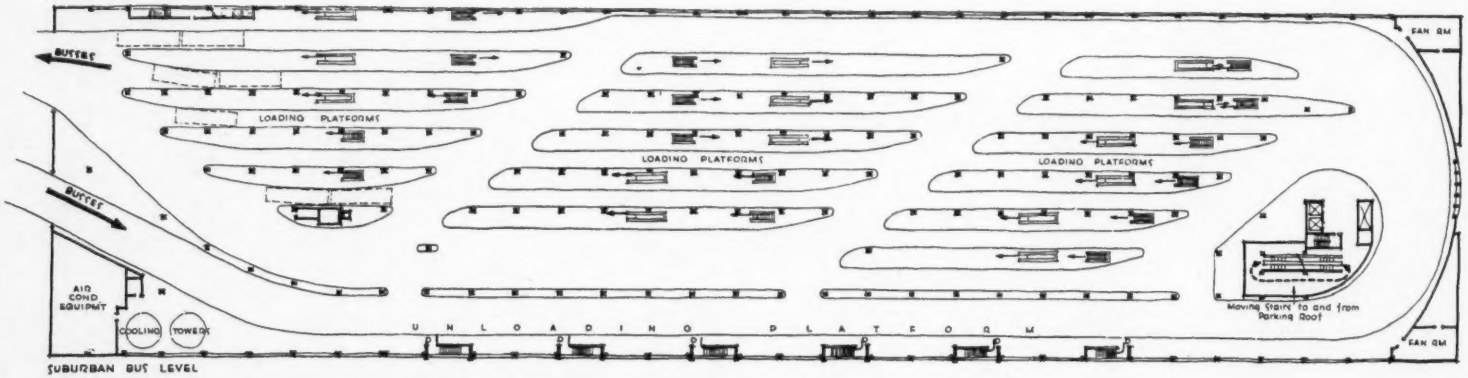




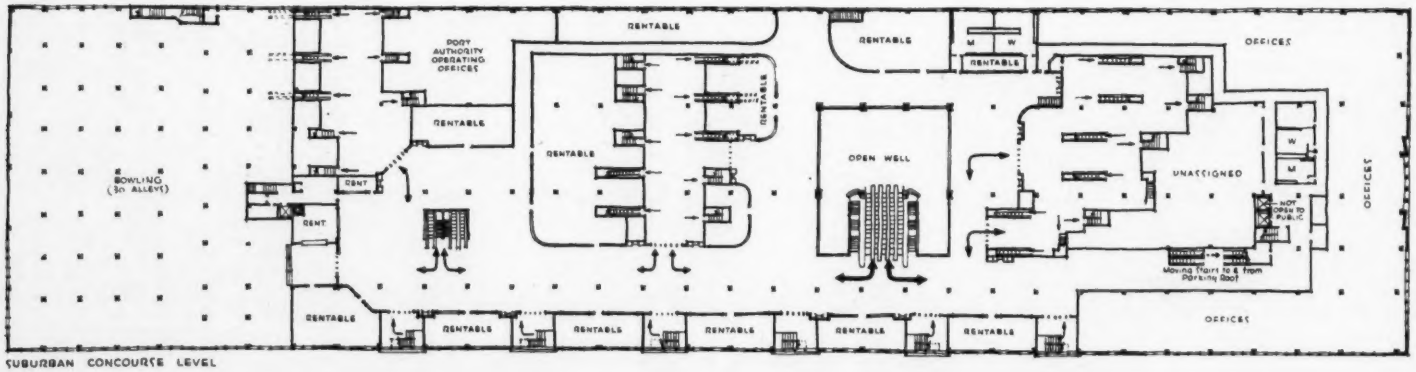
TYPICAL CROSS SECTION

LEGEND

- WOVEN WIRE FENCE
- C.W.T. CHICAGO WEST TOWNS RAILWAYS CO
- C.T.A. CHICAGO TRANSIT AUTHORITY
- TRAFFIC SIGNAL RED-AMBER-GREEN
- PEDESTRIAN "WALK" SIGNAL
- EXISTING TRAFFIC SIGNAL
- PROPOSED TRAFFIC SIGNAL
- EXISTING CONTROL
- PROPOSED CONTROL



SUBURBAN BUS LEVEL



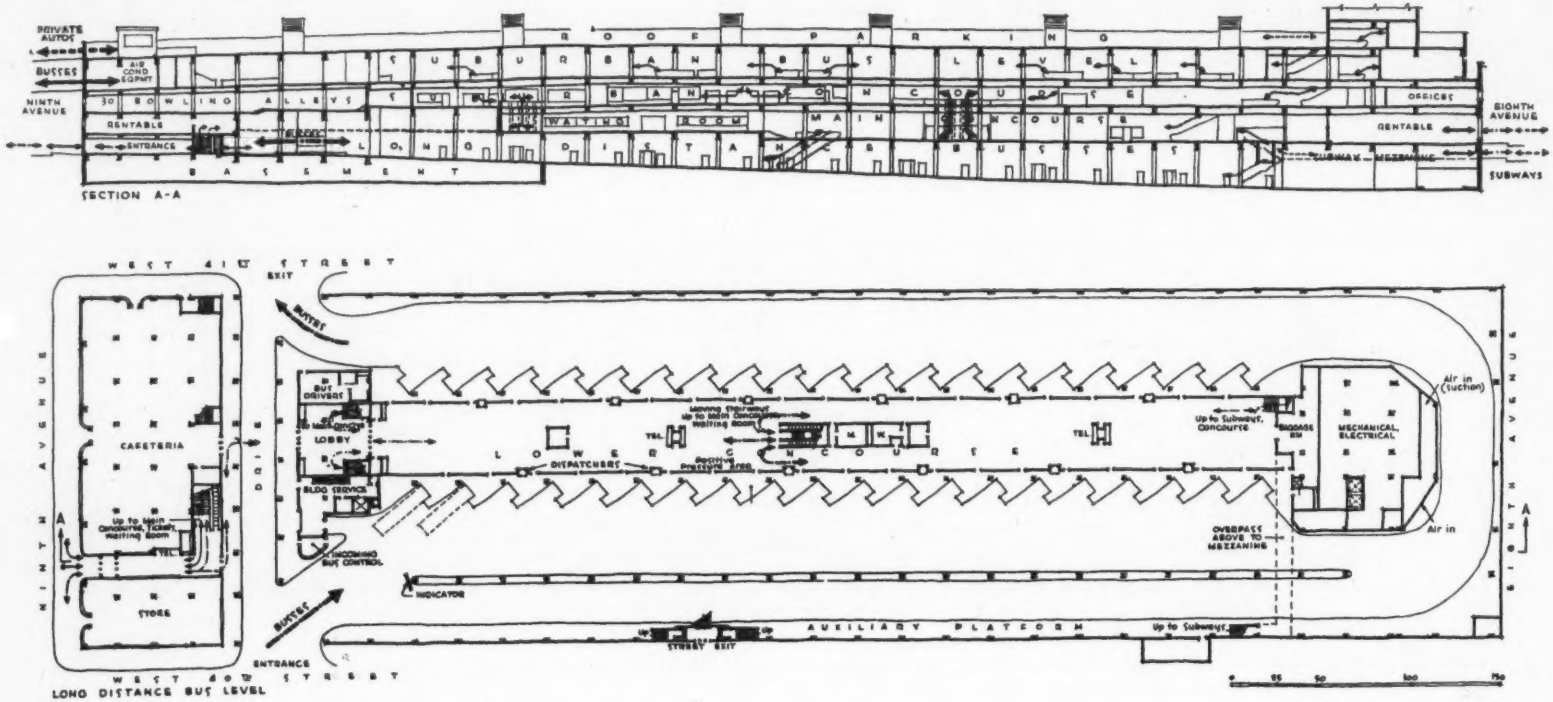
SUBURBAN CONCOURSE LEVEL

Suburban commuters and shoppers are separated into three major sorting areas on the suburban concourse level. 14 moving stairways and 16 stairs provide access from these areas to the short-haul loading platforms. On this upper concourse as in the main concourse there are numerous shops, and recreation facilities including a 30 alley bowling center. Moving stairway traffic to and from roof parking area is isolated from bus passengers.

APPENDIX NO. 4-A

Layout of
SUBURBAN CONCOURSE WITH BUS LEVEL ABOVE
PORT AUTHORITY BUS TERMINAL
New York City

Courtesy - Port of New York Authority



Incoming bus control flashes on the indicator at the entrance of terminal the number of dock that each incoming bus is to occupy. Electronic signal system keeps bus control constantly informed of docks in use. Buses will normally both discharge and load passengers at docks which open off the lower concourse.

APPENDIX NO. 4-B

Layout Showing
LONG DISTANCE BUS LEVEL AND SECTIONAL VIEW
PORT AUTHORITY BUS TERMINAL
New York City

Courtesy - Port of New York Authority

Announcing the New

"FLEX-O-LITE 831"

IMPROVED

GLASS BEAD

FOR APPLICATION TO TRAFFIC SIGNS, STREET NAME SIGNS AND LICENSE PLATES

BEST FOR WHITE AND YELLOW SIGNS

Now, thanks to better research and engineering you can have white and yellow signs with reflectivity and message legibility never before obtainable at any price. Applied at economical cost by conventional methods and "permanized" with Flex-O-Lite's amazing new STORM-COTE protective covering agent, you are assured of new highs in weather, water, dirt and wear resistance, improved day and night legibility, coupled with lowest cost. A test in your own shop will convince you. Wire, write or phone for complete details.

FLEX-O-LITE

FLEX-O-LITE MANUFACTURING CORPORATION

8303 Flex-O-Lite Drive • P. O. Box 3066 • St. Louis 23, Mo.

Check the Proven Advantages of NEW 831 REFLECTIVE SIGN SYSTEM

- ✔ Best for white and yellow signs.
- ✔ Complete angularity—full legibility up to point of passing.
- ✔ No surface glare . . . no "dead" spots . . . lasting and luminous 'round-the-clock reflectivity.
- ✔ Weather and water proof . . . dirt repellent . . . unaffected by industrial fumes and atmospheric conditions.
- ✔ Applied at low cost by customary methods.
- ✔ Available in all standard sizes for application to traffic signs; also extra fine for street name signs and license plates.
- ✔ Economical . . . saves you money . . . you perform the work right in your own shop.

Send for descriptive literature. Use handy coupon below.

Flex-O-Lite Mfg. Corp., 8303 Flex-O-Lite Drive, P. O. Box 3066 (Affton Br.), St. Louis 23, Mo.

Gentlemen:
Please send full particulars about Flex-O-Lite's New 831 Reflective Sign System.

Name_____

Title_____

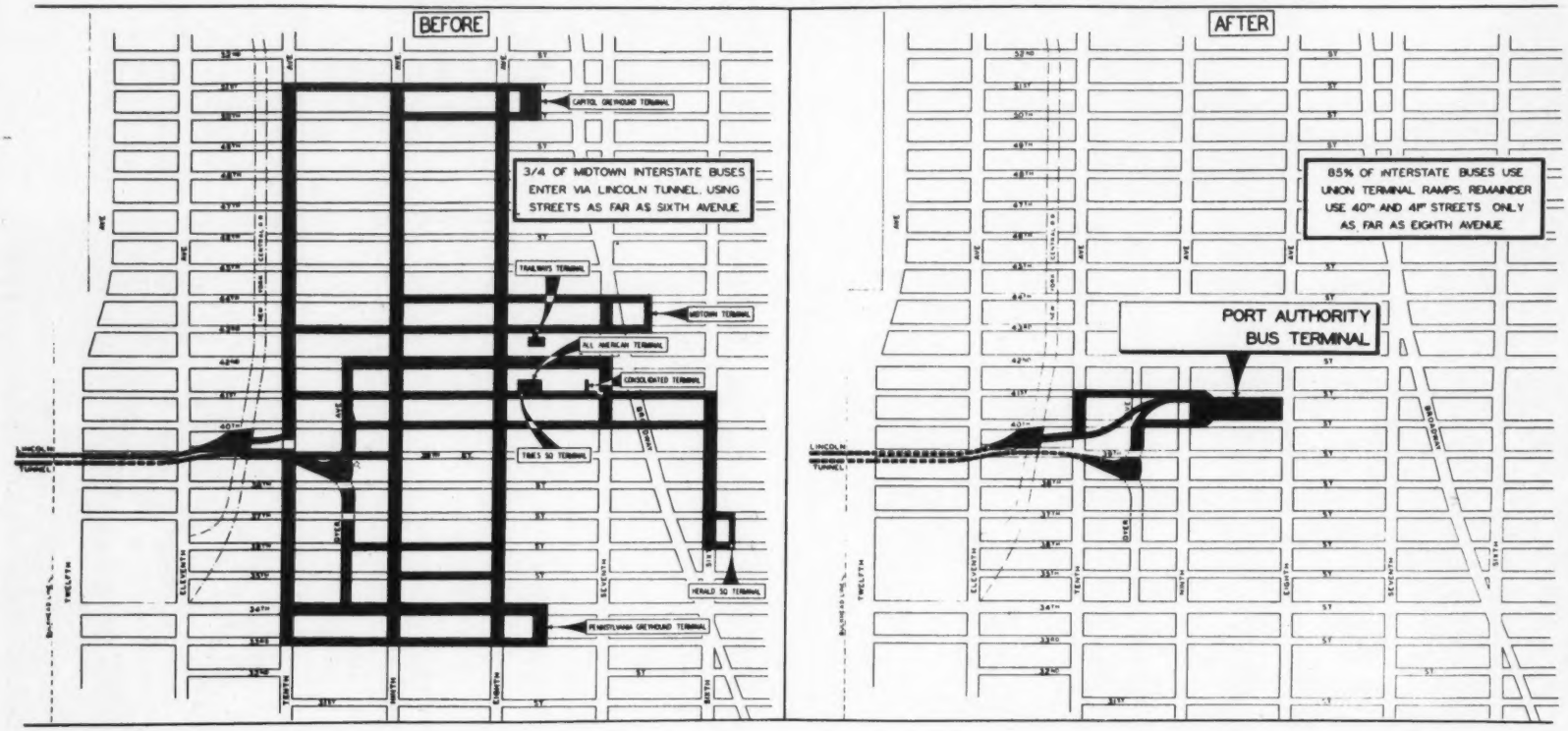
Street_____

City_____ Zone_____ State_____

APPENDIX 4-C

Diagram Showing

EFFECT OF PORT AUTHORITY BUS TERMINAL ON INTERSTATE BUS TRAFFIC THROUGH MID-MANHATTAN STREETS



Courtesy - Port of New York Authority

Announcing...

the NEW, SOLID COLOR PVC

POLY-CONE*

Tough, Durable, No Seams
will not CRACK, TEAR or BREAK!

The new SAFE-T-CONE that offers a lifetime of color without repainting. Pure, bright color is mixed into a special tough, pliable plastic. Just wash it with soap or solvents to remove dirt, grease or grime and restore original color! Made of *polyvinyl-chloride to produce the toughest, most durable cone on the market. Outlasts ordinary cones many times . . . without upkeep! SOLID YELLOW or brilliant SAFE-T-GLO colors.

SAFE-T-CONE®

TRAFFIC GUIDES

★ **ALL-RUBBER Painted or Reflectorized**

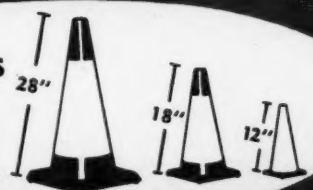
The regular, all-rubber SAFE-T-CONES, now better than ever. Painted with standard red and yellow or reflectorized for brilliant after-dark use.

★ **Plastic or All-Rubber FLUORESCENT**

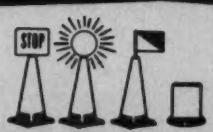
New Poly-Cones and All-Rubber cones can be furnished in brilliant orange-red fluorescent color for super-brilliance . . . day or night!

ALL-RUBBER SAFE-T-CONES COME IN 3 SIZES

28" Barricades
18" for general use
12" for line painting



New, Improved Compounds!



SAFE-T-SIGNS
FLASHER-LIGHT ADAPTER
FLAG ADAPTER
SAFE-T-MARK

QUALITY SOLDER SEAL PRODUCTS

SAFE-T-CONES®
are manufactured only by
RADIATOR SPECIALTY COMPANY
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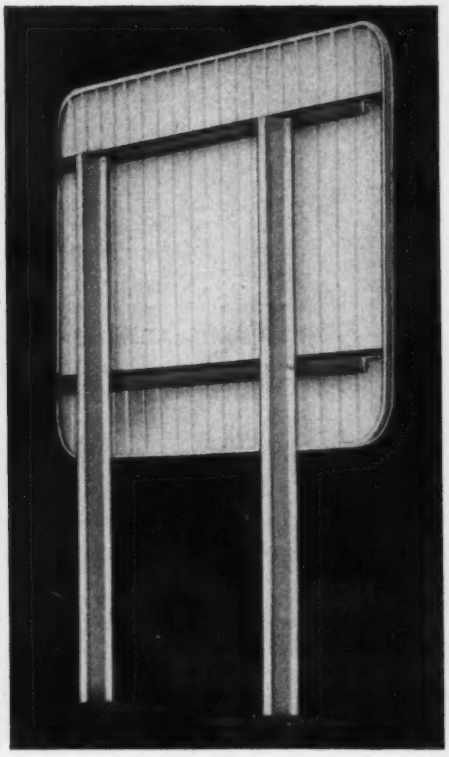

Signs and Posts of Alcoa Aluminum

GUARD LIFE AND DOLLARS ON NEW YORK STATE THRUWAY

Along the New York State Thruway, signs and posts of Alcoa® Aluminum are cutting the cost of traffic safety. Moisture that gives rise to destructive delamination or rusting of other materials is no problem with aluminum.

That means "Scotchlite" Reflective Sheeting adheres better and longer. Neither sign backs nor rugged aluminum I-beam posts will ever need painting. Even when the sign is damaged by vandalism or collision, there's no progressive corrosion to wreck the message film.

Large informational signs on this modern highway are assembled from extruded aluminum panels with integral ribs for essential rigidity. Smaller installations use flat sheet. In either case, rugged Alcoa Aluminum alloys will withstand winds of hurricane force. Aluminum adds another cost-cutting advantage in the form of light weight: both signs and posts are less expensive to ship, faster and easier to install.

Ready-to-erect signs and posts of Alcoa Aluminum are available from the manufacturers listed below. Contact the one nearest you *today*.

Always Fasten Aluminum with Alcoa Aluminum Fasteners

NEW:

Handbook on Aluminum Traffic-Control Devices

Send for your copy of this outstanding Alcoa booklet. Complete data on all aluminum sign products including specifications. Write: Aluminum Company of America 1682-A Alcoa Building, Pittsburgh 19, Pa.

These manufacturers sell various types of finished signs of Alcoa Aluminum

S. G. Adams Co.
920 Olive Street
St. Louis, Missouri

***A'G'A Division of Elastic Stop Nut Corp. of America**
1030 Newark Avenue
Elizabeth, New Jersey

Cataphote Corp.
2505 Albion Street
Toledo, Ohio

***Federal Sign & Signal Corp.**
8700 S. State Street
Chicago 19, Illinois

Gopher Stamp & Die Co.
78 Chicago Avenue E.
St. Paul, Minnesota

Grimm Stamp & Badge Co.
8105 Rosalie
St. Louis 17, Missouri

The Hunt Company
18308 James Couzens Hwy.
Detroit 35, Michigan

Lyle Signs Inc.
2720 University Ave. S.E.
Minneapolis 14, Minnesota

M-R Sign Co.
Fergus Falls, Minnesota

***Minnesota Mining & Mfg. Co.**
900 Fauquier Avenue
St. Paul 6, Minnesota

Miro-Flex Inc.
1824 E. Second Avenue
Wichita 7, Kansas

Mulholland-Harper Co.
5820 Tacony Street
Philadelphia 24, Pa.

Municipal Street Sign Co.
777 Meeker Avenue
Brooklyn 22, New York

National Safety Engineers, Inc.
3910 First Avenue, South
Birmingham 1, Alabama

Safety Sign Co.
12351 Prospect Avenue
Strongsville, Ohio

Standard Sign & Signal Co.
470 Main Street
Clinton, Massachusetts

***Traffic & Street Sign Co.**
80 Foundry Street
Newark, New Jersey

Zumar Industries
1608 Essex Street
Los Angeles 28, California

**The manufacturers noted with an asterisk furnished extruded signs for the New York Thruway.*

Your Guide to the Best in Aluminum Value

***NEW!* "ALCOA THEATRE"**
Exciting Adventure
Alternate Monday Evenings

Brighten the Stripe for Safety . . .
with CATAPHOTE REFLECTIVE TRAFFIC BEADS

Moments ago this scene lay shrouded in shadow. Then . . . out of the night comes brilliance . . . to serve the cause of safety.

Approaching headlamps spill their light upon the roadway and distant pavement markings leap from the darkness . . . as if by magic. No witchcraft, this . . . but the man-made magic of Cataphote Reflective Traffic Beads.

Manufactured from high-grade optical crown glass, Cataphote beads are highly resistant to traffic wear and the effects of weathering. Easily applied by a bead dispenser on any standard striping machine, they provide immediate reflectance and lower paint drying time. Available plain, or waterproofed for all-weather visibility.

Let the man-made magic of Cataphote Reflective Traffic Beads add nighttime visibility to your traffic markings. You'll be rewarded with increased safety, improved channeling of traffic and markings that will outlast plain stripes by 50%.

Remember . . . *any stripe worth laying is worth reflectorizing . . . by Cataphote* . . . manufacturers of a full line of non-electric traffic control products, all backed by nearly 30 years of specialized experience and research.

Cataphote
CORPORATION

TOLEDO 10, OHIO
JACKSON, MISSISSIPPI

Membership Applications

The following applications have been received since the list published in the December issue.

APPLICATIONS FOR TRANSFER

BLACHMAN, Martin M.
Traffic Engineer, George W. Barton & Associates, 600 Davis Street, Evanston, Illinois. October 28, 1957 for MEMBER grade.

CLEARY, Edward F.
Assistant Commissioner of Traffic, Department of Transit & Traffic, 401 East Pratt Street, Baltimore 2, Maryland. October 21, 1957 for MEMBER grade.

DIMITRI, Michael S.
Traffic Engineer, Ramp Consulting Services, 230 Park Avenue, New York 17, New York. December 2, 1957 for ASSOCIATE grade.

HUBBELL, Richard E.
Assistant Civil Engineer, N. Y. C. Department of Traffic, 100 Gold Street, New York 38, New York. November 19, 1957 for ASSOCIATE grade.

KISSELEFF, Louis G.
Associate Traffic Engineer, Room 480, City & County Building, Denver 2, Colorado. November 20, 1957 for ASSOCIATE grade.

LEITCH, Kenneth
Assistant Traffic Engineer, Melbourne City Council, Town Hall, Melbourne, Victoria, Australia. November 25, 1957 for ASSOCIATE grade.

LOGAN, John I.
Associate Traffic Engineer, 147 Fountain Street, Providence, Rhode Island. November 7, 1957 for ASSOCIATE grade.

LOMAX, Arthur H.
Traffic Co-Ordinator, 11 Robert Street, Hamilton, Ontario, Canada. November 18, 1957 for ASSOCIATE grade.

ROSS, Lewis J.
Design Engineer, Idaho State Department of Highways, P.O. Box 879, Boise, Idaho. October 28, 1957 for ASSOCIATE grade.

NEW APPLICATIONS

ABEND, Norman A.
Traffic Engineer, Clarkeson Engineering Company, Inc., 285 Columbus Avenue, Boston, Massachusetts. December 2, 1957 for JUNIOR grade.

CZYZ, Iwan
Traffic Engineer I, Traffic Engineering Department, City Hall Annex 1002, Philadelphia 7, Pennsylvania. November 15, 1957 for JUNIOR grade.

DUQUE VILLARREAL, Tomas G.
Inspector-Engineer, Public Works Department, Tecnica de CAM, Panama, Rep. de Panama. November 18, 1957 for JUNIOR grade.

GILEWICZ, Henry C.
Assistant Civil Engineer, N. Y. C. Department of Traffic, 100 Gold Street, New York 38, New York. November 13, 1957 for JUNIOR grade.

HEINEMAN, Paul L.
Principal Assistant Engineer, Howard, Needles, Tammen & Bergendoff. 1805 Grand Avenue, Kansas City, Missouri. November 11, 1957 for ASSOCIATE grade.

LEWIS, Brian J.
Traffic & Transportation Engineer, Porter, Urquhart, McCreary & O'Brien, 568 White-Henry-Stuart Building, Seattle, Washington. November 18, 1957 for JUNIOR grade.

LITTLE, James H.
Senior Engineer I, Missouri State Highway Department, Highway Building, Jefferson City, Missouri. November 29, 1957 for JUNIOR grade.

NUGENT, Edward J.
Traffic Engineer, Association of Casualty & Surety Companies, 60 John Street, New York 38, New York. December 3, 1957 for ASSOCIATE grade.

SEGAL, Murray D.
Traffic Engineer, Clarkeson Engineering Company, Inc., 285 Columbus Avenue, Boston, Massachusetts. December 3, 1957 for JUNIOR grade.

TOMBRE, Egil
Avdelings Ingenior, Oslo Planning Office, Trondhjemsveien 5, Oslo, Norway. November 4, 1957 for JUNIOR grade.

Yearbook Changes

ADLER, Charles, Jr. (Affiliate)
Consulting Engineer, 609 West North Avenue, Baltimore 1, Maryland.

ALLINSON, Wayne C. (Junior)
Highway & Traffic Project Engineer, Charles A. Maguire & Associates, 15 Court Square, Boston, Massachusetts.

ANDERSON, James H. (Associate)
Advanced Planning Engineer, District I, California Division of Highways, 403 West Wabash Avenue, Eureka, California.

ANDERSON, Orman K. (Associate)
Assistant Professor, Department of Civil Engineering, Mississippi State College, Box 1112, State College, Mississippi.

ASHE, Frank C. (Affiliate)
Engineer, Kopp Glass, Inc., Palmer Street, Swissvale, Pittsburgh 18, Pennsylvania.

BAKER, J. Stannard (Associate)
Director of Research, Traffic Institute, Northwestern University, 1704 Judson Avenue, Evanston, Illinois.

BARNETT, Norman C. (Associate)
Traffic Engineer, Palmer & Baker Engineers, Inc., 3004 Jefferson Highway, New Orleans 21, Louisiana.

BARRIERE, Jacques (Associate)
Assistant Director, Montreal Traffic Department, City Hall, Montreal, Quebec, Canada.

BARRY, Walter A., Jr. (Associate)
Traffic Engineer, DeLeuw, Cather & Company, 150 North Wacker Drive, Chicago 6, Illinois. SEND MAIL: 432 Ridge Road, Wilmette, Illinois.

BATES, Russell G. (Associate)
Traffic Engineer, DeLeuw, Cather & Company, 1256 Market Street, San Francisco 2, California. SEND MAIL: 21571 Royal Avenue, Hayward, California.

BILBY, William H. (Associate)
Traffic Engineer, Bureau of Traffic Engineering, Indiana State Highway Department, 102 North Senate Street, Indianapolis 9, Indiana. SEND MAIL: 1115 Oakwood Trail, Indianapolis 20, Indiana.

BLEDSOE, Byron A. (Associate)
District Manager, Concrete Products Division, American-Marietta Company. P.O. Box 6677, Station G, Atlanta 15, Georgia.

BOESEL, John L. (Junior)
Office Engineer (City), 7th & Orange Street, Riverside, California. SEND MAIL: 6742 Montclair Avenue, Riverside, California.

BRADLEY, W. W. (Member)
Traffic & Planning Engineer, South Carolina State Highway Department, 1100 Senate Street (P.O. Drawer 191), Columbia, South Carolina.

BRITTON, George R. (Member)
Traffic Engineer III, Highway Planning Div., Pennsylvania Department of Highways, 21st & Herr Streets, Harrisburg, Pennsylvania.

BUNCH, John H. (Member)
Traffic Engineer, City-County Bldg., Madison 3, Wisconsin.

BURTON, H. Robert (Associate)
City Traffic Engineer, 129 Adelaide Street West, Toronto 1, Ontario, Canada. SEND MAIL: 56 Langmuir Crescent, Toronto 9, Ontario, Canada.

CARMODY, Douglas J. (Junior)
Director of Traffic & Parking, City Hall, P. O. Box 642, Modesto, California.

CARROTHERS, J. A. (Associate)
Traffic Engineer, 101 West Third Street, Dayton 2, Ohio.

CARSTEN, Winston H. (Member)
Director, Traffic Control Department, Room 405, Municipal Building, Dallas 1, Texas.

CONRADT, Robert (Associate)
Traffic Engineer, DeLeuw, Cather & Company, 1256 Market Street, San Francisco 2, California.

DAVIS, Harmer E. (Affiliate)
Director, Institute of Transportation & Traffic Engineering, University of California, 1301 South 46th Street, Richmond, California.

FISHER, George J. (Member)
Director of Public Works, 5th Floor, City Building, Omaha, Nebraska.

FLANAKIN, H. A. Mike (Member)
Associate, Charles M. Upham Associates, Inc., 1625 Eye Street N.W., Washington 6, D.C.

GILBERT, Jerry P. (Junior)
Traffic Engineer, City Engineering Department, 521 Water Street, Jackson, Michigan.

HEATH, William D. (Associate)
Office Engineer, D.C. Department of Highways, Room 402, District Building, Washington 4, D.C. SEND MAIL: 1111 Army Navy Drive, Arlington 2, Virginia.

JOHNSON, Arnold A. (Junior)
Assistant City Traffic Engineer, 112 South 9th Street, Phoenix, Arizona. SEND MAIL: 3033 East Cherry Lynn Road, Phoenix, Arizona.

KANSMAN, Sven (Associate)
Traffic Engineer, Rader & Associates, 111 N. E. 2nd Avenue, Miami 32, Florida. SEND MAIL: 850 N. W. 199th Street, North Miami, Florida.

KINGMAN, William O. (Junior)
District Traffic Engineer, Washington State Department of Highways, Box 1717, Vancouver, Washington.

REEDER, Earl J. (Member)
Consulting Traffic Engineer, 5855 S. W. 97th Street, Miami 56, Florida.

RIGOTTI, Robert A. (Junior)
Traffic Sign Engineer, Michigan State Highway Department, Stevens T. Mason Building, Lansing, Michigan.

RISTROPH, Paul L. (Member)
Director, Department of Utilities, Room 2W17, City Hall, New Orleans 12, Louisiana.

ROBBINS, Donald O. (Associate)
Associate Traffic Engineer, Room 259, Civic Center, San Diego 1, California.

ROBINETTE, Paul S. (Member)
Commissioner, Division of Traffic Engineering, 206 Oswald Street, Toledo 5, Ohio.

ROBINSON, PHILLIP (Associate)
Planning & Programming Engineer, U. S. Bureau of Public Roads, 1705 Federal Building, Boston 9, Massachusetts.

ROGERS, Allan H. (Associate)
Superintendent of Public Works, 351 Stewart Avenue, Garden City, New York.

ROSENFIELD, David (Junior)
Engineer, Highway & Traffic, Charles A. Maguire & Associates, 14 Court Square, Boston, Massachusetts. SEND MAIL: 26 St. Paul Street, Apt. 3, Brookline 46, Mass.

ROTHWEILER, Gerald C. (Associate)
Assistant Traffic Engineer, 1812 Wazee Street, Denver 2, Colorado.

ROY, George R. (Associate)
General Planning Analyst, Port Development Department, Port of New York Authority, 111 Eighth Avenue, New York 11, New York.

SANSOM, Frederick J. (Associate)
Assistant Traffic Engineer, Municipality of Metropolitan Toronto, 171 Eglinton Avenue East, Toronto, Ontario, Canada. SEND MAIL: 4 Mossford Court, Toronto 18, Ontario, Canada.

SAYLOR, James S. (Member)
Senior Traffic Engineer, Department of Traffic Control, Room 405, City Hall, Dallas 1, Texas.

SCOTT-SMITH, L. T. (Associate)
City Plan Engineer, City Plan Commission, 235 Grand Street, Waterbury, Connecticut.

SIEGEL, Stanley T. (Associate)
Director, Bureau of Traffic Engineering, City Hall, 202 N. Alabama Street, Room 7, Indianapolis 4, Indiana.

SIMM, Eugene L. (Associate)
Traffic Engineer, Traffic Engineering Bureau, Room 212, Municipal Building, Harrisburg, Pennsylvania.

Section News

Section Meetings

MIDWEST:

Monthly meetings, third Thursday, except January, July, August and October. Contact: A. L. Forde, RAndolph 6-8000.

NEW YORK METROPOLITAN:

Feb. 6, March 20 (Ladies Night), April 17, May 22. Contact: Gordon K. Gravelle, 100 Gold St., DIgby 9-0090 for place and time.

NEW ENGLAND:

In conjunction with Massachusetts Safety Council, Boston, on March 17. Contact: M. J. Huber, Yale Bureau of Highway Traffic, New Haven, Conn.

SOUTHERN:

Next meeting in Memphis, Tenn., during Southern Safety Conference, March 2, 3 and 4, 1958.

TEXAS:

Fifth Annual Meeting, January 25, Roosevelt Hotel, Waco. Contact: R. T. Gregory, City Hall, Waco.

WASHINGTON (D.C.):

Luncheon meeting, Feb. 10, All States Dining Room.

Dinner meeting, April 2 (tentative), Baltimore. Contact: Mason Butcher, Director of Public Works, Montgomery Co., Rockville, Md.

WESTERN:

Oregon Area —

Dinner meeting during Northwest TE Conference, January 22-24, Corvallis. Contact: J. Al Head, Salem 4-2171, Ext. 210.

Los Angeles Area —

Joint Meeting with ITTE, UCLA, Hollywood Roosevelt Hotel, January 30, 6:30 p.m. Contact: S. S. Taylor, City of L. A.

Annual Meeting—

June 18 - 20, Sacramento, Calif. Contact: M. H. West, P.O. Box 1499, Sacramento, Calif.

CANADIAN SECTION

New Officers for 1957-58

S. Cass.....*President*
A. H. Lomax.....*Vice-President*
Grant A. Bacchus....*Secretary-Treasurer*
C. E. Campeau.....*Director, East*
H. F. Burns.....*Director, Central*
J. H. Harding.....*Director, West*
K. Vaughan-Birch.....*Past President*

METROPOLITAN (N.Y.) SECTION

October 17th Meeting

Fifty-four members and guests met for dinner at the National Arts Club in New York City. *Arnold G. Fisch*, Vice-President of the Metropolitan Section presided in the absence of President *Jack Leonard*.

Mr. *Fisch* introduced the speaker for the evening, Mr. *Charles Hall*, Supervising Highway Engineer, New York Division of the Bureau of Public Roads. Mr. Hall spoke on "Design Standards for the Inter-State System." Mr. Hall gave a very comprehensive and interesting review of this entire subject. There was a very lengthy discussion following talk which indicated the interests of the members in this subject.

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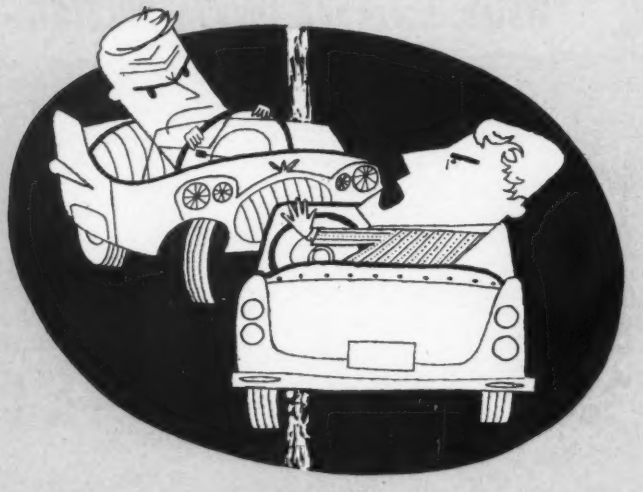

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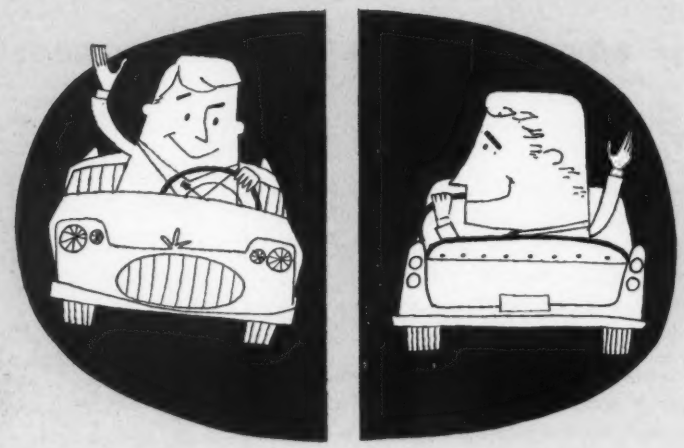

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Greater New York Safety Convenition

The Annual Convention of the Greater New York Safety Council will be held at the Statler Hotel during the week of April 14, 1958. The Traffic Engineering Session sponsored jointly by the Safety Council and the ITE Metropolitan Section, will be held in the Georgian Room at 2:00 P.M. on Monday, April 14th. This year, under the chairmanship of *Teke Wiley*, the Session will have the theme, "Engineering Traffic Safety Into Our Streets and Highways." Within this theme, *Dick Strickland* has arranged a promising program which includes: for streets, *Henry Barnes*, Commissioner of Transit & Traffic in Baltimore; for highways, *Milton Goul*, District Engineer New York State Department of Public Works; and for expressways, our own *Ed Ricker* of the New Jersey Turnpike Authority.

MIDWEST SECTION

Forty Midwestern ITE'rs and guests met at "Barneys" Restaurant November 21st for an interesting and provocative discussion on what causes expressway jams. The guest speaker was *Joseph Barnett*, Deputy Assistant Commissioner of Engineering for the Bureau of Public Roads. Mr. Barnett explained the causes of expressway breakdowns and suggested that traffic signals might be put on entrance ramps to meter traffic onto the expressway. In this manner the volume and density could be controlled so that expressway speeds could be maintained. The meeting was held in conjunction with the 1957 AASHO Convention.

Several Midwestern ITE'rs contributed to the success of the AASHO Convention. Local section President *George Hagenauer* gave a talk on "Operating Problems of Controlled Access Highways." *Mike Hartigan* spoke on the "Correlation of Signing and Geometric Design" and *Harry Harrison* participated in an Open Forum on Traffic Subjects.

OHIO SECTION

—Gene Barton, Chrmn., Publications Com.

One of the Ohio Sections highlights while in Detroit was a Section dinner meeting on Tuesday, September 24th. A total of 45 members and wives participated. The event was held at a Swedish smorgasbord-type restaurant. The food was so good that some hungry members were observed going back for more as many as three and four times. During the early stages of the evening the fine party spirit and almost serious business vein was suddenly interrupted by a war whoop from one of the members when he spotted a full size worm in his martini after having sipped half of it. After that the frightened worm made many acquaintances around the table and by the end of the evening we all learned that "plastic worms don't drink."

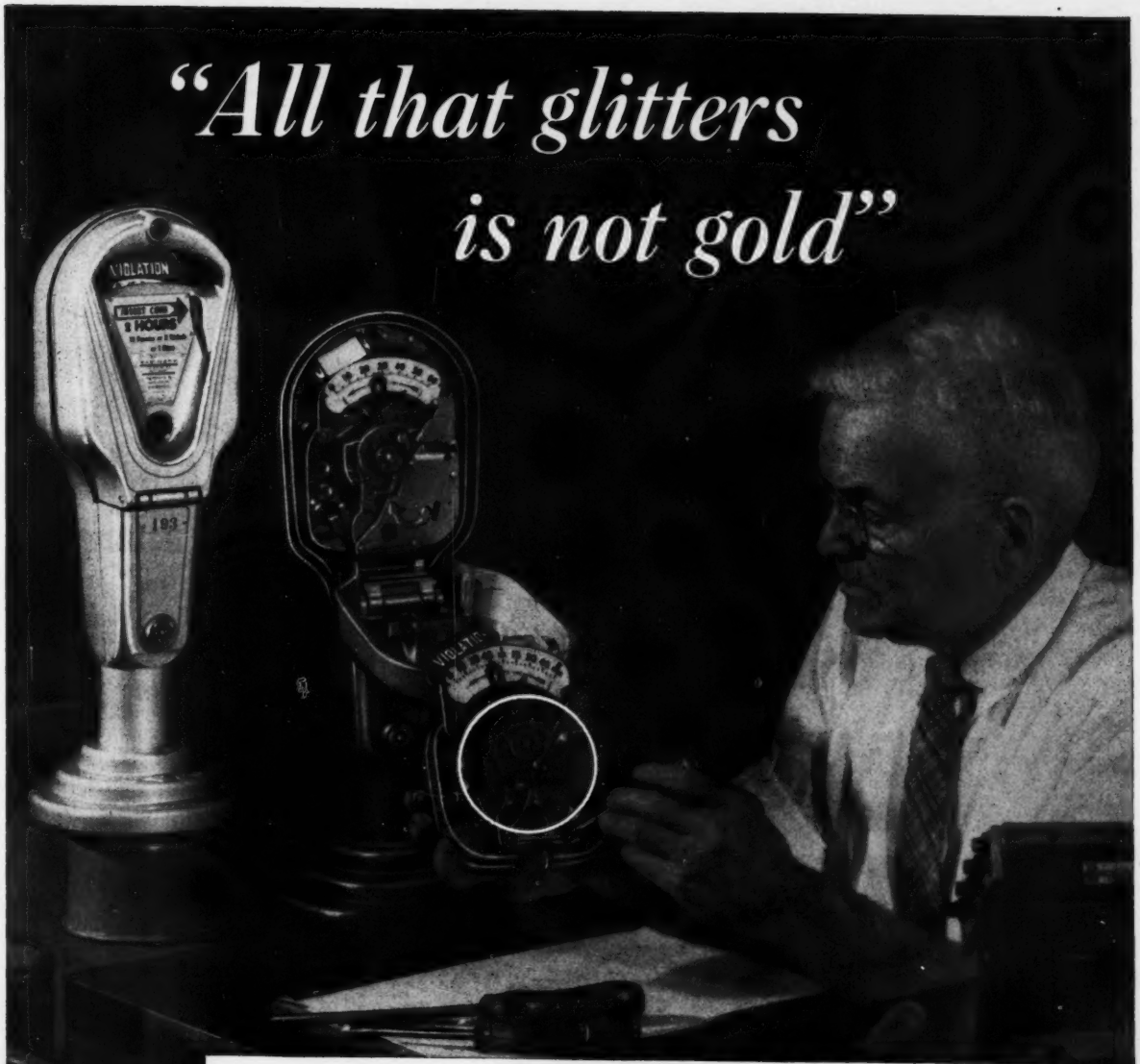
Despite the spirit of fun prevailing the members managed to get into a serious frame of mind for a while. *George Howie* gave us a Director's report on his participation in the Board of Directors meetings in June and during the Detroit meeting.

Among items of interest discussed by the group and their reaction now reported to you are the following:

Ohio Section Policy adopted re: State Legislation that each member be prepared to discuss legislative changes with legislators if approached by them. Also that each member send to *Paul Robinette* in Toledo, head of our Legislative Committee, his reaction on local

(Continued on page 50)

"All that glitters is not gold"



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DUAL PARKING METERS

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ELECTRONIC COMPUTERS *(Continued from page 23)*

Address	Contents of Address	Description of Operation	Remarks
000	01 (300)	RESET AND ADD	These two program steps cause the square of the specified number to be placed in the accumulator. The first time through the loop the specified number is the one found at address 300.
001	04 (300)	MULTIPLY	
002	02016	ADD	Location 016 is used to store the accumulated sum of the square.
003	08016	STORE	
004	01018	RESET AND ADD	In 018, a number representing RESET AND ADD 398 is stored, and this number is placed in the accumulator. Recall that the code for RESET AND ADD is 01.
005	03000	SUBTRACT	The number in 000 (which is an instruction) is subtracted. The difference will not be minus unless the address part of the number in 000 has been increased to 399.
006	11014	JUMP IF MINUS	
007	01000	RESET AND ADD	The address part of the number (instruction) in 000 is increased by 1.
008	02017	ADD	
009	08000	STORE	
010	01001	RESET AND ADD	The address part of the number (instruction) in 001 is increased by 1.
011	02017	ADD	
012	08001	STORE	
013	10000	JUMP	The process will be repeated. Each time through the loop the next successive number in the series will be squared and accumulated because of the altered addresses of the instructions in 000 and 001.
014	13016	PRINT	The computer will arrive at step 014 (from 006) only after all squares have been formed and accumulated.
015	00—	STOP	Computer stops.
016	(+00000)		Reserved for storage.
017	+00001		Constants used to modify the instructions.
018	+01398		
300 to 399	X 1 to X 100		Given Data.

accumulate and print the sum of the squares of a series of numbers, x_i where i varies from 1 to 100. Assume also that these numbers are stored in addresses 300 to 399, inclusive. One program which could be used for this purpose is shown below. Brackets are used to signify quantities that will be changed during the course of the program.

The two examples given above should give some appreciation of the techniques used in programming. Additional examples may be found in "Arithmetic Operations in Digital Computers" by R. K. Richards — D. Van Nostrand Company, Inc. — New York.

The problems of traffic engineering that are suitable for computer solution are numerous and the only limitations on the possible applications appear to be the ingenuity of the designer and researcher. The machines are quite flexible and switching from one program to another can be done in only a few minutes. In the very near future electronic computers should be working full time in most highway and traffic departments, doing a multitude of different jobs.

SECTION NEWS

(Continued from page 48)

and state bills being passed or revised. Clear reaction on National Safety Council's inventory contest for cities be maintained but that some attempt be made to improve standards.

TEXAS SECTION

—from Tex-ITE, Section Newsletter

New Interstate Sign—Texas Design!

It is most gratifying to know that one of our own TEXites submitted, in competition, the design of the new Interstate Highway network marker which won the final selection. *Dick Oliver* has won that honor and distinction. His design was one of seventy-six submitted by all of the States. The Committee on Administration of the AASHO received all entries, then chose four to be tested. These were from New Hampshire, Louisiana, a committee staff design, and the one from Texas. Final selection was Oliver's basic design, with only slight modifications, mainly color. Dick modestly states that much of the credit for selling his design to the committee goes to State Highway Engineer D. C. Greer, who was on the committee, and Mr. Clark Foster, who made up the full size signs in the District sign shop for testing.

The marker has white letters on a red top, and white numerals on a blue field. TEXites will be looking forward to seeing Dick's brain child on our newly numbered highways at some future date.

Traffic Engineering Achievement Awards

The Texas Safety Association in cosponsorship with the Texas Section of the Institute of Traffic Engineers has presented certificates for first place in traffic engineering achievement to three Texas cities representing those in three population groups. Awards were based on the inventory annually submitted to the National Safety Council. Winners were: Dallas, Lubbock, and Weslaco.

Lone Star Broadcast

Once again an area meeting took place, this time in Dallas, when nine members from four cities came together for lunch on October 31, with *Jack Hulett's* usual hospitality in evidence. Present were TEXites *Buckman, Harrison, Gregory, Carsten, Saylor, Cogger, Tipton, Brandes, Hulett* and *Paul Price*, one of KAR-TROL's technicians. The main attraction, in addition to the Waco meeting details, was the traffic monitor recording units set up in the Traffic Control office. Yards of recording tape show just when and how much traffic comes in on Central Expressway and at what speed it is moving.

M. V. Greer reports his office is now concerned with the signing of the Interstate System. In addition to sign standards, sign bridges, and their supports to consider, there are such problems as establishing control points for signing sections of the Interstate System as they are completed. Further, the signing of other highways which are concurrent with an Interstate route for some distance. A new Interstate Sign Manual is in the making which should

prove helpful. *Bill Welty* has been working on the design of sign bridges, supports, T-mounts, etc. With help from the Bridge Division, designs have been drawn for spans of from 90 to 140 feet.

Gene Maier has been traveling around the country. First to Little Rock to speak to the Southern Section of ASCE (we do not know the subject—but understand segregation was not on the program). His most recent trip was to Yale Bureau of Highway Traffic as guest lecturer (several members in Houston were concerned at first that Gene might be looking for replacements!) In between trips, Gene resigned as Houston's Director of Civil Defense—the $1.00 per year was bad enough but when the Income Tax boys deducted two cents, that was the last straw!!

Stewart Fischer of San Antonio just made our dead line after returning from a vacation trip in Mexico City. He writes, "Myra and I thoroughly enjoyed our vacation and, I was very impressed with Mexico City. It is larger (population 4½ million), and more modern than I had anticipated. Progress is evident everywhere, and a lot of work is being done to improve traffic. On many streets densely developed property is being acquired to widen streets to six lanes divided. The newspapers there, just like everywhere else, devote a lot of space to the "traffic problem" and seem to support good traffic practices.

"Time did not permit my visiting the engineers working on the traffic problems but I had a telephone conversation with their signal engineer who spoke excellent English. In the course of the conversation, I invited him and other engineers to attend our January meeting, and he seemed very interested. I would appreciate your sending me an extra copy of the meeting information as soon as it is available, so that I can forward it to Mexico City along with a personal letter of invitation.

"San Antonio is very pleased that a new route between San Antonio and Corpus Christi has been designated as a part of the interstate system of highways. This is particularly fortunate because we were ready to purchase our part of the right-of-way for this freeway, and had funds available for it. These funds can now be used for other portions of our expressway system, which will be a big help to us."

WESTERN SECTION

—from WesternITE, Section Newsletter

Los Angeles Area

On Tuesday, October 22, a most successful area workshop social hour and dinner meeting was enjoyed by over one-hundred members and guests, some of whom came all the way from Riverside, Santa Barbara and San Diego. Social Hour Host was the Pacific Union Metal Company who made certain that all delegates were in excellent spirits.

Amid the pleasant surroundings of the L. A. Police Academy (next door to the future home of the Los Angeles Dodgers) an excellent workshop on crosswalks and limit lines was presided over by *Dick Stanford*. Speakers at the workshop were *Cliff Clark, Jim Hardy, Morry Meislich* and *Hugh Gilman*.

Highlight of the evening was the appearance of *Joe Havenner*, National ITE President, as guest speaker. Joe spoke principally on the Institute's plans and hopes for the coming year together with interesting developments in the TE field. Of much interest was Joe's announcement that the 1958 Annual Meeting will be at the Deauville, a new, *moderately priced* hotel in Miami, Florida. The meeting is scheduled for the week of November 10th.

Next regular meeting of the Los Angeles Area is scheduled for January 30, 1958, in conjunction with the ITTE annual road conference. The meeting will be at the Hollywood Roosevelt Hotel.

San Diego Area

On October 21, the City of San Diego completed Phase II of the Central Business District Oneway grid, thus making 19 oneway streets with only four remaining streets to be converted under Phase III sometime in early 1958.

Al Voorhees spent two days in San Diego in his capacity as staff consultant to the National Committee on Urban Transportation, reviewing the progress and offering advice to the Transportation Research Staff.

The long-awaited revised *Traffic Interference Control Manual* for use in the San Diego area was just recently distributed to public agencies and contractors. The manual is a result of the efforts of the City of San Diego, County of San Diego, Pacific Telephone & Telegraph Company, San Diego Gas & Electric Company, and the California Division of Highways. Local ITE'rs participating in the preparation of the manual were *Marty Bouman* of the City and *Paul Fowler* of the County.

Bay Area

A luncheon meeting of the Area was held on October 10, with 19 members and guests in attendance. *Bernard Hartung* was the featured speaker, discussing the functions and operations of the California Traffic Safety Foundation. He described the major objectives of the Foundation as: 1) to organize districts and establish safety councils, 2) to work with existing councils in developing safety programs, and 3) to coordinate activities between Federal, State, County, and City agencies. The Foundation was incorporated in January, 1956, as a non-profit, non-political organization, privately financed, to provide active leadership for the prevention and control of traffic accidents. One of the most important functions of the Foundation is to educate the public in safe driving practices and in knowledge of the traffic laws. This was the first luncheon meeting of the Bay Area and was quite successful. Future plans call for luncheon meetings every other month with dinner meetings held in the intervening months.

1957 Directors of the Mid-Atlantic Section huddle prior to the Section's Annual Meeting. L to R: Overmyer, Canning, Gittens, Muffley, Comiskey.

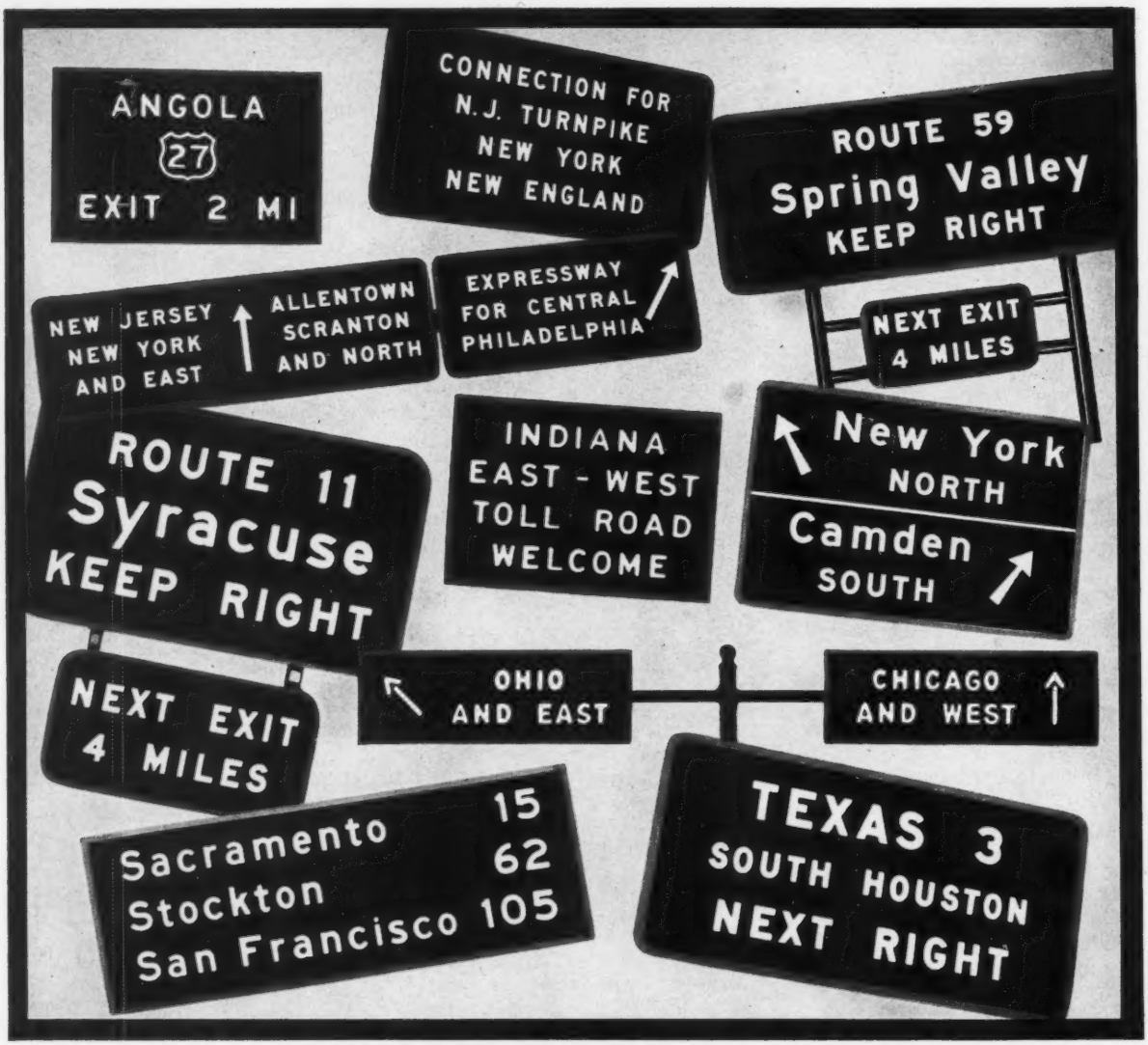
At the Mid-Atlatic Section Meeting, L to R: Past President Lew McIntyre, former Director Arnold Vey with Armand Keeley and John Horn, who were hosts to the group before dinner.

MID-ATLANTIC SECTION

Officers of the Mid-Atlantic Section were elected at the Annual Meeting held November 15 at Huntingdon, Pa. Elected were:

Paul D. Muffley.....*President*
Richard A. Overmyer.....*Vice-president*
Hartley C. Gafvert....*Secretary-Treasurer*
A. E. Keeley.....*Director*

A feature of the meeting was an inspection trip through the Prismo Corporation plant. A good crowd was on hand for the meeting which followed dinner.



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Salary: $500.00 to $600.00 per month with maximum salary obtainable through merit increases.

Apply: James W. Challis, City Traffic Engineer, Room 400 City and County Building, Salt Lake City, Utah.

MADISON, WISCONSIN

Position: Assistant Traffic Engineer.

Qualifications: Registered professional engineer to act as assistant traffic engineer in newly established department. U. S. citizenship necessary.

Salary: $657 to $767 per month.

Apply: Personnel Department, 404 City-County Bldg., Madison 9, Wisconsin.

ARIZONA HIGHWAY DEPARTMENT

Position: Assistant Traffic Engineer.

Requirements: Registered professional engineer with substantial background in traffic engineering.

Salary: $625 to $775 per month.

Apply: Personnel Division, Arizona Highway Dept., 206 S. 17th Ave., Phoenix, Arizona.

TOLEDO, OHIO

Position: Assistant Traffic Engineer. To assist Commissioner of Traffic Engineering in Traffic Engineering Division in all activities.

Requirements: Graduate engineer. Registration. Four years engineering experience, of which two years is preferably in Traffic Engineering, is desirable. Ability to initiate and supervise traffic engineering studies and investigations, planning design of traffic facilities, planning and installation of traffic signs, signals and markings.

Salary: $594.00 a month.

Apply: Employment Section, Toledo Civil Service Commission, 110 Cherry Street, Toledo 4, Ohio.

ORLANDO, FLORIDA

Position: Traffic Engineer to head separate department.

Requirements: State qualifications.

Salary: $6,000 to $7,000.

Apply: Office of the Mayor, Orlando, Fla.

LONG BEACH, CALIFORNIA

Position: Assistant Traffic Engineer. (2 positions vacant)

Requirements: Male, 21 through 55, graduate of accredited college with degree in civil or electrical, and three years of professional traffic engineering or general street and highway engineering experience. One year of graduate schooling in Traffic Engineering may be substituted for one year of experience.

Salary: $564.00 to $694.00. Appointment may be made at other than first step depending upon qualifications of applicant.

Appointment: To be based on appraisal of application, education, work history, employment record, professional standing and a confidential investigation of candidates personal qualifications and character.

Apply: Robert D. Dier, City Traffic Engineer, 502 City Hall, Long Beach 2, California.

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